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THE FUTURE SITUS OF THE COTTON MANUFACTURE OF THE UNITED STATES.*

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I have been asked to treat two subjects: 1. Is the present number or the recent increase of cotton-spindles in the United States actually or relatively in excess of the requirements of the population?

2. Is the South likely to become a formidable competitor with New England in the cotton manufacture?

I submit the facts from which I have made my own deductions, and from which each one may draw his own conclusions according to his own judgment.

When dealing with the first branch of the subject, as all are well aware, we must qualify any conclusion based on the actual number of spindles by making allowance for higher speed and greater product per spindle in recent years; hence larger relative product. On the other hand, we must qualify the data of the spindles by the consideration that the average number of yarn spun at the present time is much finer than it was twenty years ago; hence a less proportionate product per spindle.

Again, we must qualify our deductions derived from the actual number of spindles, after having made allowances for high speed and fine numbers, which may perhaps be held to balance each other, by taking into consideration the very rapid increase in both national wealth and general welfare in recent years; hence a greater consumption of cotton fabrics per capita. This increase in purchasing power and this choice of better and more expensive fabrics are very noticeable in the Southern States, and especially

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so in respect to the colored population on Sundays and holidays. After balancing higher speed against the finer number, this last element of greater power to purchase would lead us to assume, or to expect to find, a steady but moderate increase in the ratio of spindles to population: when I give the facts, I think many will be somewhat surprised at the justification which the figures will give of this hypothesis.

In treating the conditions of the South I date my computations from the year 1870. This was the year in which the worst effects of the war had been in part overcome. In 1870 our Southern friends made a fair beginning, on which they continued in rather slow and even measure in their progress until about 1880, when at last the new industries of the new South began to make progress with leaps and bounds; the greatest impetus being imputed to the Atlanta Cotton Exhibition by the Southerners themselves. It seems as if the display in this exhibition had shown to themselves, even for the first time, the wealth of minerals, of timber, and of other resources which proved to them that cotton was very far from being king even of its own land.

There is another very important factor which enters into this consideration to which no attention has been given in any treatise upon Southern manufactures that I have yet seen, namely, the great number of people in the Southern States who were clad in homespun or in hand-woven fabrics, both before the war and throughout the period of reconstruction down to 1870.

The moment attention is called to this element in the question, all will doubtless admit that a change from homespun to factory-made goods, whatever its measure may have been, was the equivalent of so much added population and so much increased demand for the products of the cotton-factories. Conversely, in any computation of the ratio of spindles to population at different dates, a deduction must be made in 1860 and 1870 for those who were at these respective dates clothed in hand-made fabrics. Perhaps it may be said, and perhaps it may rightly be said, that if an allowance must be made according to each man's judgment for all these variable elements of the problem, what dependence can be put upon the final figures? Each one may answer his own question or doubt in his own way. I shall only give what appear to be the facts, and I will say, as I have so often said before, that all statistics, unless qualified by sound judgment, are mere rubbish, not worth the compilation. I think many may be somewhat surprised, however, by the apparent certainty of the rule presented.

I have corresponded with a large number of my old Southern friends in respect to the homespun consumption of former times. I omit Texas from among the Southern States, for the reason that

it has always been more like a Western State; that it never had any considerable number of cotton-spindles within its borders, and that its people were never clad in hand-made fabrics to any considerable extent. I include under the name of Southern States Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia, including West Virginia.

In 1860 the population of these specific States numbered 9,650,000; in 1870, 10,432,000; in 1880, 13,665,000; and at the present time their population, without question, exceeds 17,000,000.

From the best information which I can obtain, and in the best judgment of old planters, dealers, and manufacturers, nearly the whole population of the middle or mountain section of these States, two to three millions in number—a very large portion of the colored people on the plantations, probably two or three millions more out of four millions—and a very considerable part of the population of country districts aside from these two classes, were clad in homespun or hand-woven fabrics prior to 1860. The average of the estimates which I have received would put more than one half, or about five millions of the population in 1860, of these Southern States into this class.

In 1870 very moderate progress had been made in displacing hand-made fabrics with the products of Southern factories, but the more prosperous people were consuming more Northern goods of finer quality. The average judgment of my correspondents indicates that in 1870 at least forty per cent of the population were clad in hand-spun or hand-woven fabrics. I estimate it at one third, numbering three and a half millions, in my succeeding computations.

At the Atlanta Exposition Mr. F. E. Clark, of the Pemberton Mill, and myself, computed the product of two hand carders, two spinsters, and one hand-loom weaver, who were working on thirty-two-inch Osnaburgs, about thirty-six picks to the inch, at eight yards a day of ten hours. Five operatives in the Pemberton could have turned out eight hundred yards of the same fabric in the same number of hours.

In my computation of the ratio of spindles to population I deduct 4,800,000 in 1860; 3,500,000 in 1870; in 1880 I make no deduction for hand-work, for the reason that the art was then nearly a lost art. A few home spinners and weavers may still be found only in the heart of the mountains of Kentucky and North Carolina. On this basis the cotton-spindles of 1860, numbering 5,235,727, bore the ratio of one spindle to each of 5·05 of the remaining population; 1870, spindles 7,132,415, one spindle to 4·92 of the remaining population; 1880, spindles 10,653,435, one spindle to 4·71 of the total population; 1889, September 1st, spindles estimated

by the "Financial Chronicle," 14,175,000, one spindle to 4·52 of the probable population, now computed at sixty-four millions.

Our exports have varied, but not enough to affect the average materially. They are a little more in value now than they were in 1860, but not so much in ratio to product. These facts appear to sustain the theory that the increased purchasing power of the population will sustain a small relative increase in spindles per capita.

Now, any one can form his own judgment as to whether or not the spindles are in excess of our present population. In view of the greater variety of uses to which cotton fabrics are now put, in view of the greater purchasing power, in view of the very low prices of cotton fabrics, and in view of the extravagant habits of the people, my own judgment is that the spindles are *not* in excess of the population; on an even balance we may of course be subject to an overstock of special goods, such as affects some classes, especially export goods at the present time. In the long run I think that we are more likely to require a ratio of one spindle to four than to go back to the ratio of one to five persons. We now gain in population nearly or quite two millions in a year. The average of the next ten years may be two million two hundred thousand each year. On the basis of two millions which is substantially the present rate, if we require one spindle to each five of the population, we must add four hundred thousand new spindles every year to our present number; at one to four and a half, four hundred and forty-four thousand; at one to four, five hundred thousand, besides providing for the increasing wants of the existing population. It would then appear that we may require five million new spindles in addition to our present number during the next ten years, to meet the increased home consumption of cotton fabrics, no consideration being given to any increase in exports. Please do not exaggerate the importance of this forecast, and don't be in a hurry to double your investments.

Five hundred thousand spindles a year will only cost sixty to eighty million dollars, varying according to the number of yarn. Now, all life and progress consist in a conversion of force. We convert the food, the fuel, and the clothing which we consume—

1. To sustaining life.
2. To an increase of capital.

We may, therefore, take any single element of our food as a standard by which to measure the relative increase of our capital into which it may be in part converted. My favorite standard is the *egg* standard! Agassiz went to the egg to find the unit of life, I go to the egg to find the relative standard of production and of savings. Don't crow very much over your own little egg; it may be only a Bantam. If each adult of the present population con-

sumes hens' eggs at the rate of consumption in your own factory boarding-houses, the hen-yards of the country now supply about one hundred and twenty-five million dollars' worth of eggs a year, and by exchange and conversion into capital this sum would suffice to build all these cotton-factories and to supply the working capital as well, year by year.

Again, in *two* years only out of this ten ensuing, as much capital will be expended in the construction of new railroads in this country as the whole five million spindles which we may need in *ten* years will cost.

Or, again, if we assign only five hundred dollars to the construction of a dwelling-place to each five persons comprised in this increase of population, the capital which will be needed to house them will come to two hundred and twenty-five million dollars a year, or $2,250,000,000 in all.

So the world wags on, always within one year of starvation, within two years or so of being naked, and within a few years of being houseless and homeless, except for the work which we must do to supply the products which we must exchange with each other—eggs for cottons and cottons for eggs, etc.

This may be a pleasant prospect for our machine-shops. They will also have a good deal of work to do in substituting new spindles for old, and perhaps new looms for old, if the double-faced, fast-running, vertical loom does the work which is expected of it. How soon will your present noisy, cumbrous, and unscientific loom be invented out of existence? When will it be displaced by a smooth-running, circular loom? How about your carding-engines, your drawing and your combing machines? Are we to go on importing them? Yes, until the taxes are taken from the metals and from the other crude materials which are needed to make them. Iron has cost you for ten years previous to the present year (1889) ten dollars per ton on the common grades, and steel fifteen to twenty-five dollars per ton more than the same materials cost the machinists of Great Britain; thus enhancing the cost of your capital, and placing you at a disadvantage in competition with the manufacturers of Great Britain, Germany, Belgium, Switzerland, and almost all the other manufacturing countries in which such materials are free from taxes. The lower the prices of metal the greater this disparity.

I think we shall not even secure our home market, much less extend our foreign sale, so long as the prices of crude materials are kept by taxation far above those of our competitors. If, however, there should be a change in the policy of the country, to which all events appear to be tending, and to which the advocates of both sides of the tariff question appear to be moving, and it should be decided that the crude materials, commonly called

"raw materials," and the partly manufactured products which are necessary in the processes of domestic industry, should be imported free of tax, I think there could then be very little doubt that we should not only control our home market, but also secure a much larger share in supplying other nations with cotton fabrics than we now enjoy. The number of our spindles might then be almost indefinitely extended; and when the prices of iron, steel, and copper are the same in this country as they are in Great Britain, making allowance for the cost of transportation, as they would be if free of duty here, I doubt if any carding-engine, combing-machine, or spinning-machinery, or any other important part of the plant, except some specialties, could be imported from any other country.

The annual consumption of iron and steel in this country is now thirty-five to forty per cent of the commercial or known product of the world. It is equal to the entire commercial product of the world in the years 1865 and 1866. It is in excess of the largest product ever made by Great Britain. Now, it is upon supremacy in iron more than anything else that the control of commerce rests, and I think we shall soon hold it without lowering our prices materially, but in consequence of rising prices abroad. The deposits of fine iron ore suitable for making Bessemer steel are rapidly diminishing in Great Britain in ratio to the demand upon them. The coking coals, which are necessary in the work, are becoming more costly year by year. As the mines become deeper they become hotter, and the veins in Durham, the chief source of supply, are only two feet wide, and they lie horizontally, so that the miners must work at a great depth in a very heated atmosphere, lying on their sides. As the necessary consequence, although the wages of labor are much less, the cost of coke is much higher than it is in this country.

Great Britain now imports twenty per cent of all her ores. The chief supply of fine ore has been in the neighborhood of Barcelona, Spain, but that supply is becoming exhausted. When that time comes, Great Britain must get her supply of fine ores from the south of Spain—inside the gates of Gibraltar—from Algiers, or from mines not yet worked to any great extent, three hundred miles from the extreme northern end of the Baltic Sea, in Sweden.

The supply of workmen capable of operating iron-furnaces and steel-works in Great Britain is also relatively small, so that with each advance in the price of iron, an advance in wages is demanded—not due to improvements in the processes, but due to the relative scarcity of laborers. On the other hand, the demand for iron upon the furnaces, both of Great Britain and of this country, which for many years varied with the activity or

depression in the construction of railroads in this country, is now active. The very rapid extension of railways, not only upon this continent but upon other continents, has induced an enormous demand for iron and steel for other purposes. Therefore, during the last years, 1888 and 1889, although the construction of new railways diminished from the standard of 1887 by fifty to sixty per cent, yet the demand for iron and steel has gone on increasing, and is now larger than was ever known before.

Again, the new sources of supply in this country are rapidly furnishing iron at low prices, but at such profits that the production increases very rapidly so as to meet the increasing demand. In spite of this, there are indications of an insufficient supply of iron the world over, from which, of course, the present rising prices have ensued. Now, the production of iron is a matter of relatively small consequence, either in the value of the product or the number of men employed, as compared with the consumption. Gauged by my favorite standard, even the present large production of iron in the United States is only equal in value to the product of hens' eggs.

Now, suppose for an instant that under these conditions of increasing demand we were to remove the duties. New England would at once supply herself with ores and coal from the vast and easily worked deposits of Nova Scotia. The New England production of heavy machinery would be resumed, and we should no longer send to Milwaukee for our heavy stationary engines, but should again make them either at South Boston or in Providence. Even then it would be doubtful if the supply of iron could keep up with the increasing demand.

Then imagine, if you can, what would be the effect upon the price of iron in Great Britain, if we were to call upon her only for a million tons extra, or only for the increase which we shall require next year. That would be a demand for about twelve and a half per cent in addition to the present product of her iron-works, and even the present product can not be kept up without a great increase of cost. Witness the recent statements in the London "Economist" to that effect.

Finally, let it be assumed that, without any reduction in the present low price of iron in this country, the consumers of iron in Great Britain—the machinists, the builders of ships, of locomotives, the makers of rails, and the like—were called upon to pay as much for their iron and steel as our consumers of iron now pay, what would be the result? They have had an advantage ranging from five to ten dollars per ton of iron, and from fifteen to thirty dollars per ton of steel, for many years, over our machinists, engine-builders, and ship-builders. Imagine what the conditions would be, if you can, if our relations were reversed, and

if crude iron and crude steel could be had at lower prices in this country than in Europe; yet that is what is more likely to occur than anything else, and that time would be greatly hastened by the instant removal of duties on ore and coal, and perhaps by the immediate removal of every duty on pig-iron, although prudence might require a period of five years or so to carry out the latter policy by successive reduction.

I think we have been protecting the machinists, engine-builders, and ship-owners of Great Britain, and retarding the progress of our own, by keeping up a disparity in the price of the materials which form the chief element of cost from fifty to a hundred per cent higher in this country than they have been there. How can we expect to keep the control of the home market on machinery when the duty on the materials is fifty to a hundred per cent higher than on the machine itself? I think it is time this question was taken out of politics and settled by sensible men in a sensible way; but that may be a visionary theory, which I may not live to see reduced to practice.

I speak of this subject because it has a most important bearing upon the question which has been put to me. We can readily overstock our own market, which is small compared with the demand of the world. Glance at the accompanying pictures which represent the present conditions of the cotton manufacture of the great empire of China. In No. 1 is seen the cotton growing; in No. 2, the clearing from the seed by snapping a bow-string with the hand, which gave the name of "bowed Georgia" to Southern cotton before Whitney invented the saw gin; No. 3 shows the press; No. 4 the spinning-wheel, No. 5 the warper, and No. 6 the hand loom, as they have been in use since prehistoric times. In one of these pictures there is a bit of evidence of manual dexterity which is hardly credible: one woman appears to be spinning three strands from three separate rovings on one wheel.

The latest and most authentic computation of the population of the globe is fourteen hundred millions. The manufacturing or machine-using nations of the world—that is to say, the nations which have to any considerable extent adopted the factory system of making textile fabrics—consist mainly of the inhabitants of this country, of Canada, of Great Britain, France, Germany, Belgium, Holland, and Switzerland, numbering in all about two hundred millions.

The only nation, and, in fact, perhaps the only country, which makes cotton fabrics to any extent in excess of its own consumption is England. We import more cotton fabrics than we export, but they are chiefly of the finer kinds, or else they are laces, embroideries, and the like. I am not quite sure, but I think that even France and Germany import more cotton fabrics than they

No. 1.—Cotton Culture.

export, if the fine yarns are included in their import, which can only be made for them in Lancashire. There are, as you are aware, a few cotton-factories in Russia and a few in India, but their product in ratio to the consumption of the continent of Asia is utterly insignificant.

The number of people who are at this time clothed in hand-spun and hand-woven fabrics is more than double the number of those who yet purchase the fabrics which are made in our factories or in those of any other nation. I made a computation a few years since, and I think the conditions have not greatly changed, to this effect: that all the cotton fabrics exported from Europe and from the United States to China would only suffice to clothe sixty to seventy millions out of a computed population of four hundred millions—even at the ratio of only two and a half pounds of cotton to the head. I consider that ratio incorrect, although it is commonly used.

A large part of China in which there is a very dense population, and to which most of our drills and sheetings are sent, is in the same latitude as the northern United States. It is not as cold, but yet it is a cold country, and the common people are clad wholly in cotton fabrics. Here are one of their coats and some of their other garments. You can judge for yourself whether or not they consume more than two and a half pounds per head. This coat alone weighs nearly four pounds.

At five pounds per head, which is a much more reasonable estimate, the factory-made fabrics of this country and of Europe would not suffice to clothe more than ten per cent of the population of China. There has been an ill-defined dread lest China should build cotton-factories and then should undertake to clothe us with the products of the cheap labor of the "heathen Chinee."

Now, entirely aside from the fact that low-priced labor is not cheap labor, and that high-priced labor is cheap because more effective in making goods at low cost, I venture to ask if any of my readers ever bought or spun any Chinese cotton? I think very few of the present generation have had any experience even with Surats or India cotton. I think those who know even what India cotton is will not dread any serious competition from that, and the very few—perhaps I am the only one who ever bought any Chinese cotton—will after that experience lay aside all fear of Chinese competition in the contest for supremacy in the cotton manufacture. It is the whitest, cleanest, and most honestly packed, but also the shortest, meanest, and most worthless cotton of which I ever attempted to draw the staple or to put through a factory.

The Appalachian chain, gathering the moisture from the Gulf

Stream and spreading it over the fertile cotton-fields of the United States, has fixed our supremacy in cotton production and probably in the cotton manufacture of the future, until Egypt is more fully redeemed from barbarism, or until the lands bordering upon the Paraguay and Parana Rivers in South America are more fully occupied by a dense and industrious population.

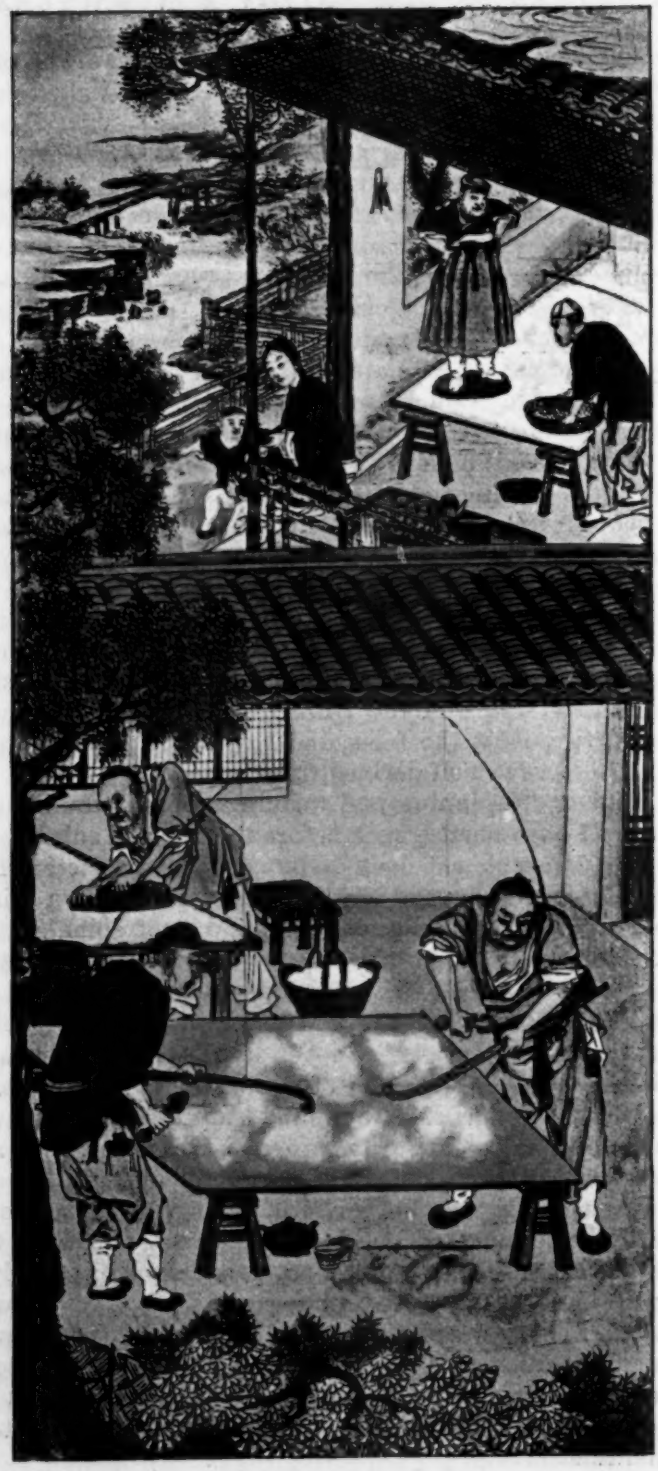
But perhaps the seat of the cotton manufacture of the future may not be wholly where the cotton grows. Cotton is a sun-plant. It thrives best and yields the largest product in the hot, dry years when the dryness does not become a drought. The very characteristics of climate which promote the production of the fiber are to some extent inconsistent both with spinning and weaving, which call for a cool, moist atmosphere. The variety of Dacca muslin so fine as to have been called the "woven wind" is spun and woven only in the early morning by weavers who sit upon the ground under the trees where the humidity of the air is greatest. I believe they even dig a hole in the ground, in which they sit, so as to bring the web in front of them close to the ground.

This brings us to the question of prime interest to all of us. Will that Southern cotton land also become the principal site of the cotton manufacture of the United States? Upon this question I will first submit the facts, and I will then give the conclusions which I have myself derived from them.

The number of spinning and weaving mills in the Southern States which I have named, both before the war and subsequently down to 1870, was not sufficient to be considered a factor of any considerable importance. In 1860 the number of Southern spindles was about five per cent of the total number of spindles of the country. They were in by far the greatest proportion devoted to spinning coarse yarns to be woven upon hand looms and converted into Osnaburgs or into jeans, the latter mostly of the so-called "butternut variety"; goods dyed with the butternut dye, which color gave the name to the Confederate uniforms.

There were a few considerable and successful mills devoted to both spinning and weaving; notably at Columbus, under the able supervision of William H. Young and John Hill; other mills at Augusta, the Graniteville Mill, and a very few others.

In 1870 the number of Southern spindles was nearly three hundred and twenty-eight thousand, gradually and slowly increasing, down to 1880, to five hundred and forty-two thousand. In this period looms were being added to many of the spinning-mills, and the change was going on from the homespun to the factory-made goods. It is only since 1880 that the additions have been made to the spindles of the South which have attracted so much attention.



No. 2.—Cotton Ginning.

According to the "Financial Chronicle," there were in the Southern States named, in the cotton year 1888–'89, two hundred and fifty-nine factories, averaging a little over five thousand spindles each, giving a total number of one million three hundred and forty-four thousand five hundred and seventy-six spindles in operation, with thirty-one thousand four hundred and thirty-five looms. The number of yarn spun was a fraction under No. 14—a gain in the fineness of the yarn, since my computation of 1880, of one number only.

If we deduct the few large mills, the average of the greater number is about four thousand spindles, ranging from one to six or seven thousand. The Southern consumption of cotton had increased from one hundred and eighty-eight thousand seven hundred and forty-eight bales in 1879–'80 to four hundred and eighty-six thousand six hundred and three bales in the last cotton year. In addition to the spindles in operation, a few have been added, and it is estimated by the "Financial Chronicle" that, on the 1st of September of the present year, there were one million four hundred and fifty thousand spindles in the Southern States, of which about one million are in the States of North and South Carolina and Georgia. The list given in the Baltimore "Manufacturers' Record" gives a greater number, but many mills in that list are only projected. I therefore adhere to the carefully prepared statistics of the "Financial Chronicle."

It is on the Piedmont plateau that you are to look for competition if anywhere in the Southern country. The mills will be built upon the foot-hills of the Appalachian chain; in the uplands rather than upon the lowlands of the South. On the foregoing statement there has therefore been a gain in the twenty years that have elapsed since 1869 in Southern spindles, mainly in the last ten years, of about eleven hundred thousand spindles; certainly very rapid progress. But now let us look at the other side.

The gain in the population of these same States since 1870, on the basis of an estimate of our present population made by the Actuary of the Treasury Department, has been six million six hundred thousand. At the ratio of five persons to a spindle this absolute increase in the population of these same Southern States has called for the product of one million three hundred and twenty thousand spindles, or two hundred and twenty thousand in excess of the actual gain in the Southern factories. At the ratio of four and a half persons to a spindle, which is the present average, the gain in the population in these States requires the product of fourteen hundred and sixty thousand spindles. In these computations no cognizance is taken of the displacement of home-spun fabrics.

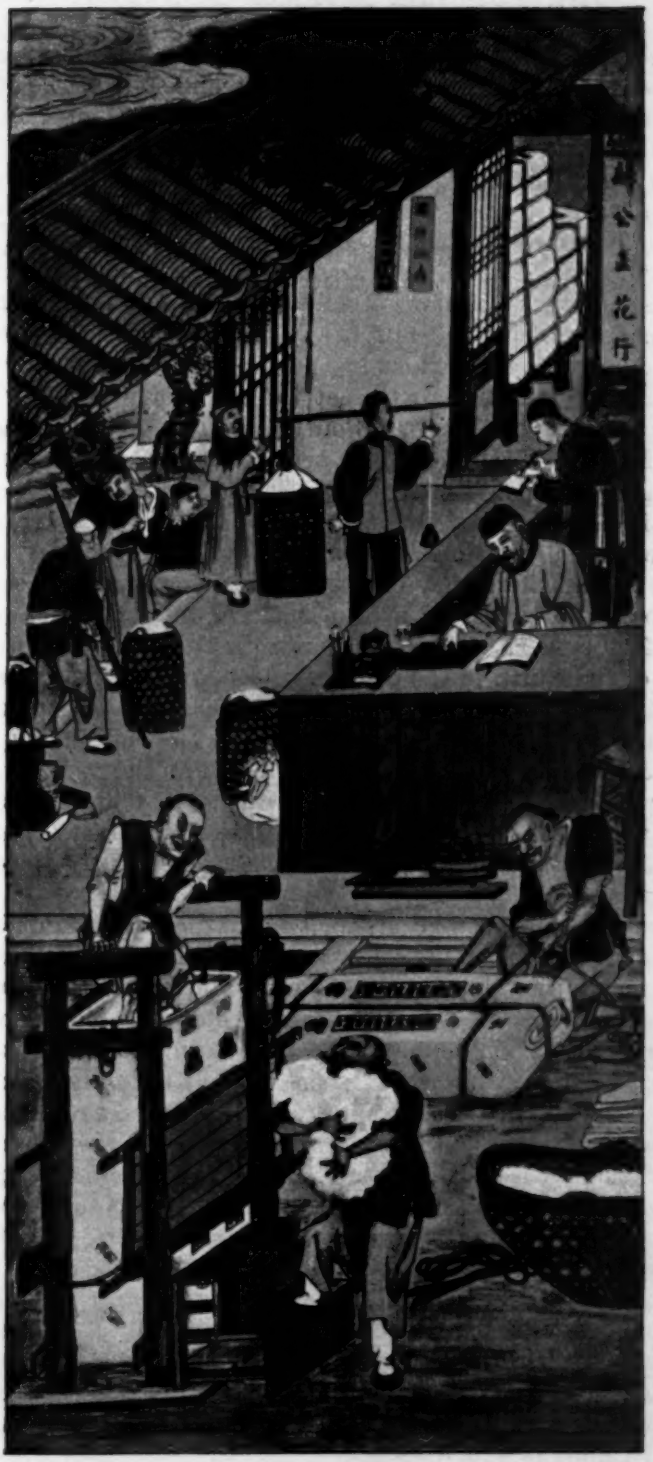
If my computation is correct, that three and a half million

people, who were clad down to 1870 in homespun fabrics, have changed to factory-made goods, in which estimate I am very much more than sustained by my correspondents, that change calls for seven hundred thousand additional spindles at the ratio of one to five, or seven hundred and eighty thousand at the ratio of one to four and a half.

These statistics, so far as they prove anything, therefore prove that while the spindles of the South have gained eleven hundred thousand since 1870, the demand of the South for cotton fabrics at the average of the country has increased in a ratio of more than double the product of their own increase of spindles; and I think all our observations tend to confirm these statistics.

A few sheetings and drills have been exported from the Southern factories and a few Southern goods have been sold in the West, but at the same time there has been a constantly increasing demand upon the North for medium and fine goods. These Southern goods which we have heard of from our salesmen were all made in the larger factories, which are well equipped with modern machinery—many of them being operated by men who would succeed anywhere—but they do not yet constitute a rule, nor must we forget or disregard the personal factor in dealing with this question. It is upon the personal factor, much more than upon proximity to the cotton-field, that the success of the Southern factory will depend. The advantage of position was only measured at a cent a pound four or five years ago. The freight from central Alabama to New England is now less than three quarters of a cent a pound. Very soon it will be down to half a cent; then what? The greater part of the Southern factories are, as you observe, too small to be economically worked, averaging but a fraction over five thousand spindles each. So long as these small factories are devoted to supplying Southern neighborhoods and Southern communities with checks, plaids, and heavy brown cottons, for which there is always a demand in that section greater than any other, they will succeed or fail according to the skill and aptitude of the owner or manager. It may have been observed that within the last few weeks there has been an overstock of these peculiarly Southern goods, and an effort has been made to check the production. Some of the Southern sheetings which have lately appeared in Northern markets must, I think, have been sold at less than cost.

I have referred to the personal factor as the main element in settling this question. In a small factory, wherever it may be, there must be such personal interest or individual ownership as to secure the necessary skill and judgment in the conduct of the work, and there must not be a set of stockholders who like cormorants swallow their dividends and demand them without regard



No. 3.—Baling and Pressing Cotton.

to the conditions of the market. In the larger mills, especially when owned by a corporation, the establishment must be of sufficient size to command the services of the most competent men, especially in the manufacturing department.

Does it not follow, from all these facts which I have submitted, that the competition of the Southern with the Northern factory, *down to this time*, has been more theoretical than practical? Is it not yet to begin, if it is felt in any considerable measure in respect to the home consumption of the East, the Middle States, and the West, aside from a very few heavy sheetings which have been sold in our Northern markets?

I must, therefore, again repeat the word of warning which I have so often given to my Southern friends: Beware of the isolated cotton-factory, and also beware of the small corporation; do not proceed upon the idea that, because the factory is near the cotton, it possesses any great advantage. Men who begin in a small way and who grow up with their business, or who have learned it elsewhere, may succeed, as many are now succeeding; but those who subscribe to the stock of an isolated Southern cotton-factory with the notion that a cent a pound or less advantage over the North in the price of cotton will assure success may get their experience at a high price when some other shrewder man buys the mill at a low price. In any event, under present conditions, not less than ten per cent a year on the cost of machinery should be charged off to depreciation. In many mills which I have visited, at least that portion of the machinery was going into the cost of the goods; in some cases without the knowledge of the owners.

Now, as to the future center or *situs* of the cotton manufacture. If you glance over the history of nearly all the principal arts, you will find that there has been a tendency for them to concentrate in special sections of given countries or states. Where and how such arts may originate may be to a certain extent a matter of chance; but, once established, it seems as if not only the manual skill and aptitude but the mental force of the whole neighborhood adjusted themselves to the special condition of these particular arts. Some one man invents or improves the machine, begins his work in one place, and makes money at it. This attracts attention; others gather in the neighborhood, and presently that place becomes the center of that specific art.

Go to Gloversville, in New York, away off on the high hills north of the Mohawk River: the whole population makes gloves and mittens. The art has existed there for so long a time that it has affected the language. If you are invited out to tea, when you are offered sugar and cream the hostess will ask you if you "take trimmings with your tea."

No. 4.—Cotton Spinning.

Go to Troy. One man invented nearly all the machinery on which the laundry-work is established, and all the laundries are called "Troy laundries." Then, since the laundry is the necessary adjunct of the shirt-factory, Troy and its neighborhood have become the center of the shirt, collar, and cuff manufacture. In this art the cutting and making of the shirt have been so perfected that it costs less to make the shirt than it does to do the laundry-work upon it and get it ready for sale; while the women who operate the sewing and ironing machinery earn higher wages than even your best weavers, because they make the shirts at the lowest cost. It is only the woman who sews poorly who is a poor sewing-woman.

Go to Foxborough, Mass.—the whole population makes straw hats; over at Taunton and in that neighborhood, tacks and brads; down in Connecticut, around Meriden and Waterbury, all the brass-work of special kinds. Go to Leicester Hill, the important occupation is making cards for your factories, with some offshoots in Worcester. Even a single art divides up. Lynn makes fine boots and shoes for women; Brockton, common boots for men; Spencer, heavy boots for men.

The Dundee orange marmalade is another instance. Why should orange marmalade be made in Scotland, and not in Spain, where the oranges grow? I think the immediate benefit to the people in Florida, Louisiana, and Georgia might be greater in the introduction of the marmalade manufacture rather than in that of the cotton fabrics. The capital of a single cotton-mill would establish a great many marmalade-factories, and, like the eggs, there might be no end to the consumption.

Now, for one reason or another, the art of spinning cotton centered in Lancashire, England, first starting in and around Manchester. It stays in Lancashire. Manchester remains the center of the trade, but the trend of the spindles is away from Manchester proper. The spinners have for some years built nearly all the new mills at Oldham and other towns, seven or eight hundred feet above the sea-level, on the crest of the ridge beyond which the moors stretch away to Scotland. They may not have known why they went there, but it is the point where the relative humidity of the atmosphere is most constant. The rainfall is only about half what it is in Massachusetts, but the relative humidity of the atmosphere is very high, and you are always looking out for a shower. The dry, bad days for spinning are when the wind is from the east—that is, the dry wind in England coming over the land.

They are building a ship-canal to Manchester at an enormous expense, estimated at ten million pounds, or fifty million dollars, in order to save the railway freight on cotton from Liverpool to

Manchester; but when the cotton reaches Manchester it will be taken over upon the cars and hauled up this heavy grade. The spinners did not make this change without a reason. What was it? Can there be any reason except the climatic conditions?

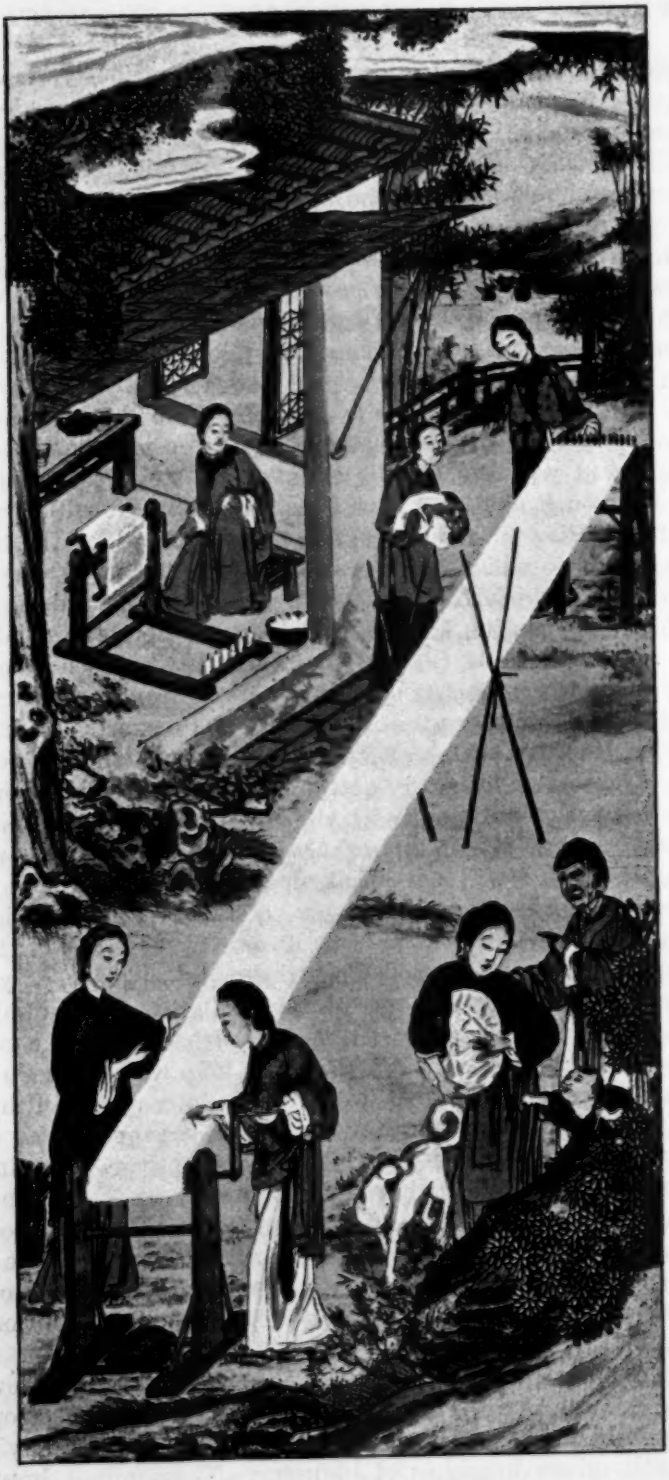
Our textile factories first gathered in centers where there was water power. It happened that Samuel Slater landed in Rhode Island, midway in the section where, I think, the cotton manufacture will stay. But water power carried many mills away up into New Hampshire, down into Maine, and elsewhere. That influence has gone by. Steam has taken the place of water power.

My judgment has been for a very long time that, barring one element which I will treat later, the greater part of the cotton spinning and weaving of this country will tend to concentrate along the south shore of New England, from New Bedford by way of Fall River, Narragansett Bay, and so on along the Sound, at the points to which coal can be carried in barges at very moderate cost, to which the cotton can be brought at diminishing rates of transportation from the South, and where the conditions of life are comfortable, the supplies abundant, and where all the subsidiary arts will gather or have gathered around the factories.

It is along this shore that the Gulf Stream exerts an influence somewhat like that which affects Lancashire. Although perhaps less in degree, the humidity of the atmosphere is more constant and more nearly consistent with the best conditions for spinning and weaving than it is in any other section of this country within my knowledge. I will not speak dogmatically upon this point, because I do not think we yet know enough of atmospheric conditions to be able to determine this question. It is one of the elements of the case. As this concentration takes place, as you so well know, the relative number of spare hands and the number of repair hands in each factory will be diminished; thus the general expenses will be reduced. The draft for help will be made upon the whole population, and the work will be subdivided in the way which is most conducive to the very closest economy.

To what extent weaving will be separated from spinning we have yet to see. I think that separation will go on as the work becomes finer and more dependent upon the changing fashion and fancy of the season than upon its quality for the sale of the product. That tendency is clearly apparent in the increase of fine spinning-mills in this section, in which no weaving is done. I have called attention to these points before.

Again, I am inclined to believe that any very rapid development of Southern cotton manufacture will meet a check from the yet more rapid progress of our Southern brethren in many other apparently minor branches of industry. These minor branches,



No. 5.—Reeling and preparing the Warp.

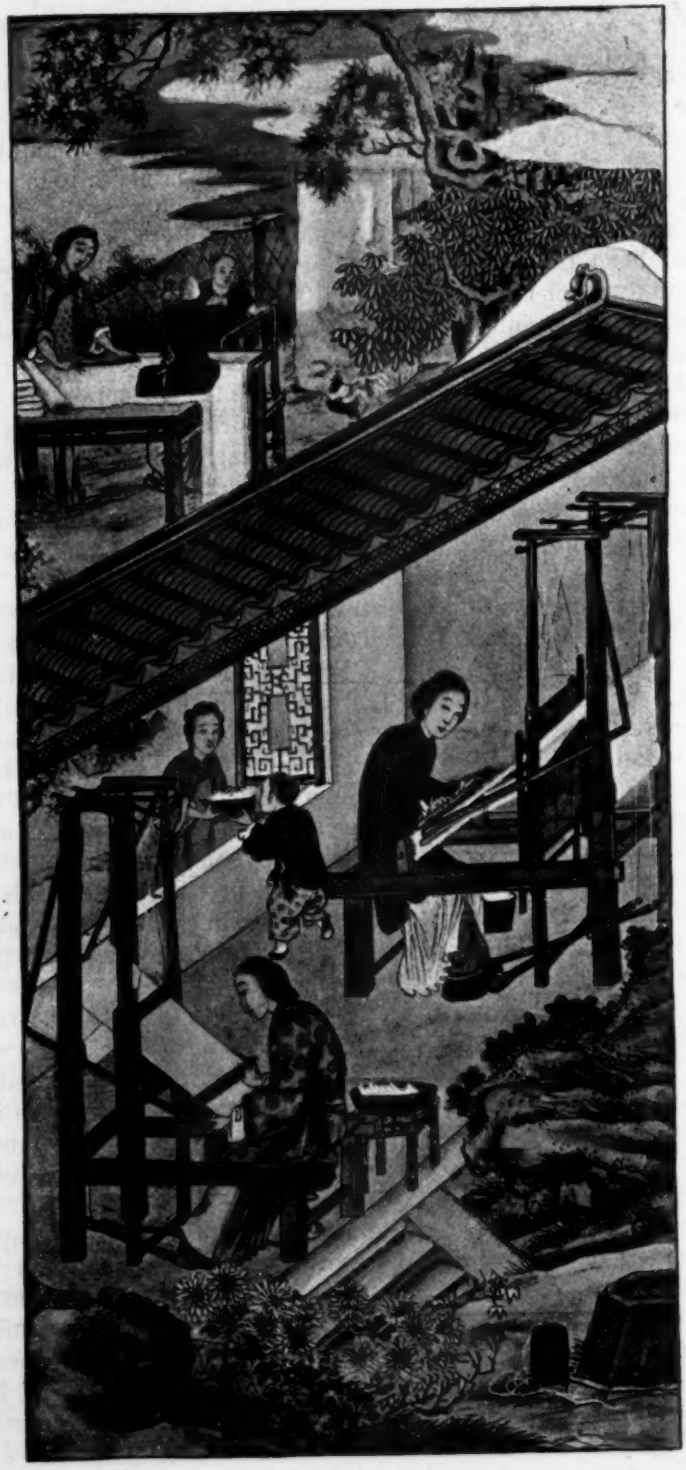
in the aggregate, are more important to the state and more conducive to diversity of occupation.

There has been up to this time a large reserve of unemployed people who could be drawn from the mountain sections of the South, where the factory-made fabrics have displaced the product of the spinning-wheel and of the hand loom, by which these people had been habituated to the textile industry. They are an excellent class of operatives, and, in passing from their isolated, narrow, and penurious lives on the hills to the factory and its surroundings, they have made a step in progress corresponding to that which occurred in New England when the farmers' daughters left the household and filled up the factories away back in 1840 and 1850. But it will be remembered that, with the progress of wealth and common welfare, all the farmers' daughters of New England have gone up and out of the textile factory into better paid branches of work, which are less monotonous, and which are more conducive to a satisfactory life.

The farmers' daughters earned from one hundred and fifty to one hundred and seventy-five dollars a year for thirteen hours of arduous work each day, in a low-studded, stove-heated, badly lighted, and non-ventilated factory. The French Canadians, who now in greatest number occupy their places, earn about twice as much per day and more than twice as much per hour, working ten hours per day, in the modern factory which I may presently show can yet be made a chosen sanitarium. As the earnings have advanced with the improvements in the processes and conditions of the work, the cost of the product has diminished, while the workman has received an increasing proportion and the capitalist a diminishing proportion of the joint product; but there was far greater opportunity for women to change from the factory to other branches of work in New England in former times than there will soon be at the South. We at the North were always a versatile people. We always had variety of occupation, whereas in the South nearly all the minor arts of life are in a very imperfect stage and in the very beginning of development; hence the change may be more rapid from the factory to other occupations.

Now, where it requires a thousand dollars or more of capital to set one woman at work in a cotton-mill, it only calls for two hundred or so to set one woman or man at work in a shoe-factory, in a clothing-factory, in a saddler's shop, or in any of the minor arts which may be counted by hundreds—each inconspicuous in itself, but the aggregate giving employment, even here in New England, to a force to which our factory population bears but the ratio of a small fraction.

I have stated the natural law which I think will be one of the



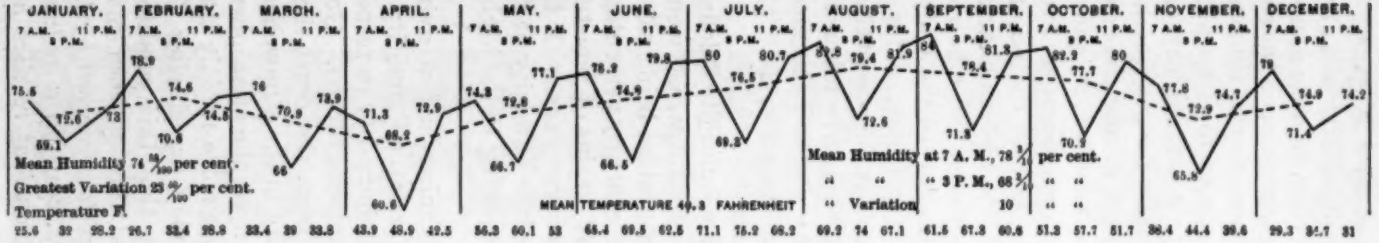
No. 6.—Cotton Weaving.

forces tending to concentrate the more important branches of the cotton manufacture along the south shore of New England. I hesitate to treat the subject of the influence of relative and absolute humidity upon cotton spinning and weaving, because none of us have yet any very accurate or scientific knowledge upon the subject; but, in order that a beginning might be made and the basis of an investigation might be laid down, I wrote to General A. W. Greely, giving the terms of the problem in a general way, and he has very kindly and carefully prepared tables for me which it might be judicious to incorporate in this report, giving the mean relative humidity three times a day—at 7 A. M., at 3 P. M., and at 11 P. M.—as well as the temperature. These observations are averaged separately for each month in the year, and in the accompanying tables the mean for five years, 1881 to 1885, is charted. My hypothesis had been that somewhere between the elbow of Cape Cod and Staten Island the cotton manufacture of the United States would gradually concentrate. That hypothesis, so far as relative humidity may be a factor in the case, is fully sustained by these tables. From General Greely's figures I have taken the mean temperatures at the same hours of the day and the mean relative humidity in New London, Conn., and Augusta, Ga. The conditions are shown by curves on these charts.

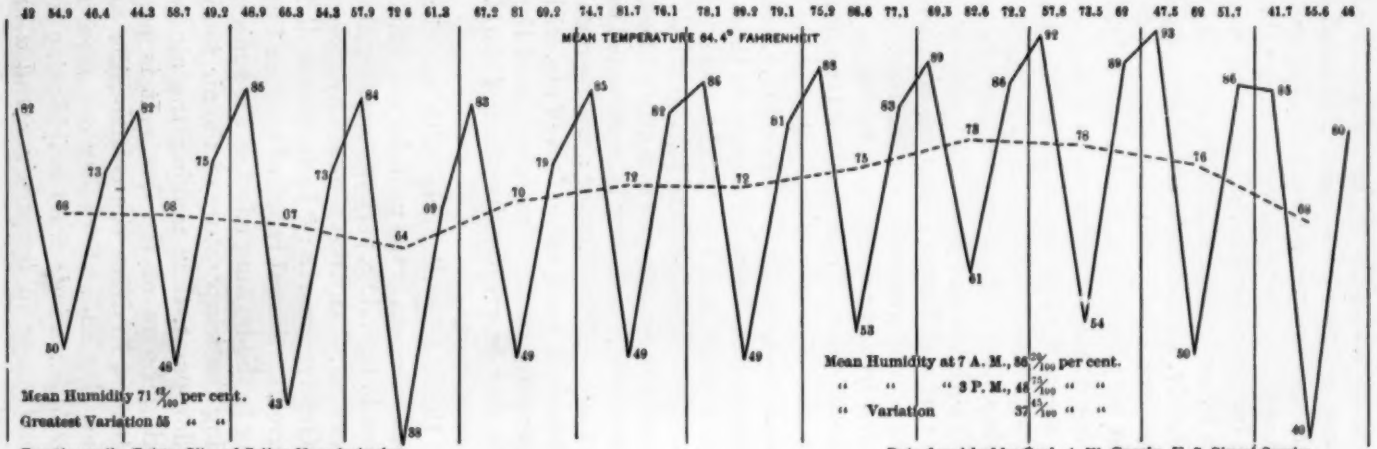
As is quite well known, the term "relative humidity" defines the ratio of the moisture in the air to the amount which would saturate the air at a given degree of heat. Saturation being called one hundred, this factor is represented on the chart by percentage. The absolute humidity, or absolute number of grains of moisture contained in each cubic foot of air, will of course vary with the temperature of the atmosphere, and the absolute humidity at the South may be greater than that of the North, owing to the higher degree of heat.

I think all will agree with me that spinning and weaving depend more upon the uniform conditions of relative humidity in respect to spinning, perhaps more on absolute humidity in respect to weaving, than upon almost any other climatic condition. General Greely remarks: "In locations distant from the coast there is a greater diurnal range of relative humidity in the atmosphere, owing to the heating effect of the sun's rays upon the atmosphere, causing the temperature of the air to increase more rapidly than the dew-point, thus making the air relatively dry during the working hours of the day. It is possible that this condition has tended to drive the cotton-mills toward the southern coast of New England, where *they are more completely covered by the vapor laden winds from neighboring waters, causing a reduced diurnal range in temperature and a more constant relative humidity.*"

RELATIVE HUMIDITY AND TEMPERATURE AT NEW LONDON, CONN., 1861 TO 1865, INC. AVERAGE PER MONTH OF THREE OBSERVATIONS PER DAY, EACH MONTH.

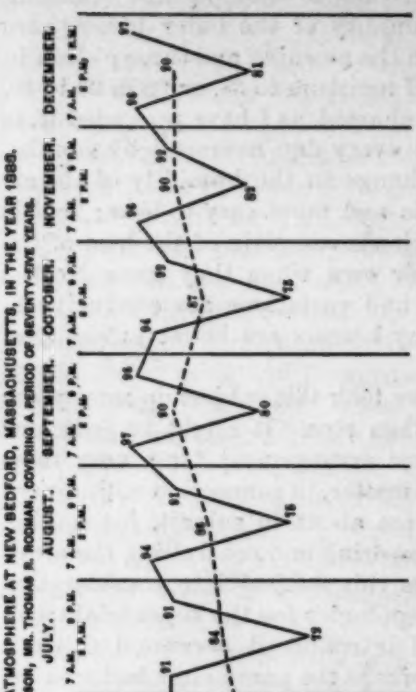


AUGUSTA, GEORGIA, 1861 TO 1865, INC.


MEAN TEMPERATURE 64.4° FAHRENHEIT
Mean Humidity 71 67/100 per cent.
Greatest Variation 55 " "
Mean Humidity at 7 A. M., 86 39/100 per cent.
" " " 3 P. M., 48 75/100 " "
" Variation 37 63/100 " "

Treatise on the Future Site of Cotton Manufacturing.
New England Cotton Manufacturers' Association, Oct. 30th, 1859.

Data furnished by Genl. A. W. Greely, U. S. Signal Service.
Charted and Compared by Edward Atkinson, October, 1869.


APPROXIMATE STATEMENT OF THE MEAN RELATIVE HUMIDITY OF THE ATMOSPHERE AT NEW BEDFORD, MASSACHUSETTS, IN THE YEAR 1868.
COMPUTED FROM THE RECORD KEPT BY THE LATE SAMUEL RODMAN, AND HIS SON, MR. THOMAS R. RODMAN, COVERING A PERIOD OF SEVENTY-FIVE YEARS.
JANUARY.
FEBRUARY.
MARCH.
APRIL.
MAY.
JUNE.
JULY.
AUGUST.
SEPTEMBER.
OCTOBER.
NOVEMBER.
DECEMBER.
Mean at 7 A.M., 82.53
" " 2 P.M., 77
" " 9 P.M., 82.30
Mean of Year, 87.35
Mean Variation, 7 A.M. to 2 P.M., 10.43

In the chart which I have referred to, I have compared the relative humidity of the atmosphere at New London, Conn., with that of Augusta, Ga., from General Greely's tables, and I have added the data of New Bedford, Mass., from the private records which have been kept for a very long period by Mr. T. R. Rodman and his father. I have also compiled some data relating to Atlanta, Ga.

The general results derived from these two charts prove that the mean temperature of Atlanta is 12¼° Fahr. above that of New London, with 13¼ less per cent of relative humidity, and subject to a vastly greater variation day by day. Augusta, perhaps the principal center of the cotton manufacture of the South, yields a little different result: the mean temperature of New London through the year is 49¾°; at Augusta, Ga., 64·4°, a difference of a little over 15° in heat. The mean relative humidity at New London is 74·53 per cent; the greatest variation in the year, 23·4 per cent; the mean variation, 10 per cent. At Augusta, Ga., however, the mean relative humidity is 71·42; the extreme variation 55 per cent, and the mean variation 37·45 per cent in relative humidity, or nearly four times as much as at New London.*

* Since this paper was written, through the action of the New Bedford Board of Trade, Mr. R. C. P. Coggeshall has been

Now, I think no one would care to attempt fine spinning under a hot sun where the humidity of the outer atmosphere changed between seven o'clock in the morning and three o'clock in the afternoon from 84 per cent of moisture to 38, or from 93 to 50. Bear in mind that the variation charted, as I have presented it, is the mean variation of each and every day, averaged by months. It will be observed that this change in the humidity of the air makes the heat more comfortable and more easy to bear; that is the reason why our Southern friends complain of the heat of the summer as compared with their own when they come North; but, whether these conditions and variations are conducive to spinning and weaving cotton, my hearers are better judges than I am.

It may be remembered that we took this subject up some years ago, but I do not think it was then ripe. It might be judicious for the association to make some arrangement for a very thorough and complete study of this matter, in connection with a very visionary proposition which I am about to submit, for making use of freezing apparatus in tempering and controlling the air of factories. I was unable to take this subject into consideration until very lately, and I need to apologize for the superficial treatment which I have given it. I introduce it because I think it may be a most important and perhaps the paramount factor in determining—

1. Where the coarse work, 13 to 20, may be done.

2. Where the medium, 20 to 40, may be carried on without disadvantage.

enabled to furnish the figures by means of which the mean temperature and the mean relative humidity at New Bedford have been compiled for the year 1881. The results are as follow:

Mean temperature, dry bulb	48·9° F.
Wet bulb	46·4° F.
Mean relative humidity, 7 A. M.	90 per cent.
Mean relative humidity, 2 P. M.	74 "
Mean relative humidity, 9 P. M.	90 "
Mean of the year	84 "
Maximum during the year	100 "
Minimum during the year	60 "

I have also received readings for the mean relative humidity of Prestwich, a suburb of Manchester, in Lancashire, but not situated high above the sea on the crest, like the Oldham district, Prestwich being only 294 feet above the sea-level. The readings for 9 A. M. show a mean relative humidity of 84 per cent; for 9 P. M., 87·6 per cent. There is no midday observation. The variations morning and night correspond very closely with those of New Bedford, the relative humidity being a little lower.

I am led to believe, from all that I can learn, that so far as atmospheric conditions constitute a factor in cotton-spinning, the conditions of the southern coast of New England, where the climate is affected by the moisture from the Gulf Stream, are as favorable as those of Lancashire to any kind of work.

3. Where the medium fine work, 40 to 80, ought to go.

4. Where the finest, 80 to 200, or upward, must go, unless we can prepare a special atmosphere for each class of work.

I looked over a few numbers of the reports of the Royal Meteorological Society of Great Britain, and, while I find there are great variations in the relative humidity of the atmosphere in different parts of Great Britain, the changes are not as great as they are in this country, even between morning and night. I can not find any midday record as yet. I have sent for one.

Neither have I been able to find a record of a manufacturing town, but I should infer that the conditions of Buxton, one of the stations, might correspond to Oldham, Preston, etc. Buxton is, as you know, an inland health-resort on the peaks of Derbyshire, not far from Manchester, about a thousand feet above the sea-level, not much higher than Oldham, and facing the Gulf Stream. The mean temperature of the year at 9 A. M. is 44·15°; 9 P. M., 42·5°; extreme temperature, 1888, 79·2°; mean relative humidity at 9 A. M., 90 per cent; 9 P. M., 92 per cent; highest point, 95 per cent; lowest, 80 per cent; variation, 15 per cent. No wonder it rains easily where the atmosphere is within less than 10 per cent of the saturation point almost all the time.

Since dictating the foregoing statement, Mr. Clayton, of the Blue Hill Observatory, has kindly computed the mean relative humidity of the atmosphere at Greenwich, England, from data within his possession, for the years 1884, 1885, and 1886. The mean of the hours 7 A. M. and 3 P. M. is 87 per cent; the extreme variation, from 95 per cent of humidity at 7 A. M., October, 1886, to 49 at 3 P. M., August, 1884. As I have before stated, the changes at Greenwich are very much greater than they are in Lancashire. I hope to procure figures for Lancashire, which I have sent for, before this report is published.

I have thus given some of the apparent advantages of New England over the South. I will now present some of the advantages of the Piedmont plateau, of the foot-hills, and of the upland country of the South, for the manufacture of coarse fabrics, even though the extreme of heat in the summer months is less conducive to continuous work throughout the year than the extreme of cold of our winter climate, and even though the humidity, both absolute and relative, of that section of our country is very much more variable than upon the south shore of New England.

While pointing out the advantage upon coarse numbers, I also call your attention to the indications that the demand of this country for coarse and unbleached fabrics is relatively diminishing while the consumption of the finer bleached and printed fabrics is relatively increasing. As soon as people can afford to wear a "b'iled" shirt rather than a gray cotton, or a fancy satine

rather than a common print, they will have them and they can now well afford to pay for them.

I was under the impression until I took up this subject that the North had a positive advantage in pure water for bleaching and finishing, for the reason that all the rivers south of the lower margin of the glacial drift, which ended at the mouth of the Delaware River, are muddy or turbid during a large part of the year, and there are no ponds or lakes of clear water; hardly any of any kind in the cotton States. My correspondence with Mr. John Hill has disposed of this superficial doubt by calling my attention to the facility with which very pure and very soft water may be derived either from abundant springs or from artesian wells. There is no point to be made against the South on bleaching and coloring.

Again, so long as the supply of native operatives suffices, there may be a great field hardly yet occupied, in the production of coarse rather than of fine cotton fabrics, without trenching or taking away from us any part of the work which we can do in the best way. I think our Southern friends may develop a very important branch of textile industry in spinning and weaving below No. 20.

It will be observed that this whole problem turns upon an average advantage claimed by the South over the North of about one cent a pound in the price of cotton. This present advantage, whatever it may be, will be reduced whenever the volume of Southern railway traffic becomes greater and freight charges are cut down; but it may always be a considerable point on heavy goods. There is not, however, the full difference of the freight between the North and the South. Very few mills can supply themselves with cotton, even in the South, from the immediate neighborhood; and, when cotton must be baled and put upon cars for transportation, the local rates are apt to be quite heavy for short distances.

The advantages claimed by the South on account of the longer hours of work can not be admitted. In the first place, they will soon be shortened, either from choice or necessity; and, in the second place, I doubt if any very skillful manager now thinks that high speed can be profitably maintained more than ten hours a day.

Again, it is claimed that wages are lower in the South than in New England. This is true. The rate of wages is lower, but I doubt if the cost of labor is any lower, if as low. It may be in a very few of the best managed mills, but in taking the census of 1880 I made a very careful computation of the proportion of hands to spindles and looms, and after making every allowance for difference in yarn, in number, and in quality of mills, I found that

there were substantially two hands employed in the South against one in New England, and this computation has been sustained by my observation in such mills as I have visited.

Now, it is well known that the more hands the more waste, the more want of discipline, the more lack of good work. In a recent report on Russian spinning by our friend Mr. Dobson, who spoke to us on carding-engines, he reaches identically the same conclusion in comparing Russia with Great Britain.

Doubtless there has been great improvement in Southern methods since 1880; with increased efficiency, the number of hands decreases; but the wages or earnings rise, and will continue to do so, until they become equal to what we pay.

I am, therefore, confident that we may hold a long lead, and that we need not yet borrow trouble from any competition in Southern factories after they have learned to keep their depreciation account, and after they cease to run the risk of bankruptcy by working their machinery into their fabrics without charging it off.

I might here rest my case; but I will venture to give a few more facts bearing upon this subject.

There is one development of science which may render the cotton-factory entirely independent of climatic conditions. One of the visionary theories which I presented many years ago has not yet been put into practice in any great measure. I suggested preparing the atmosphere which is to be used as an instrument for taking away the moisture from the slashers by carrying it into the sizing-room through a chamber filled with ice. Since that date there has been immense progress in the art of freezing. Frozen carcasses of mutton are now carried from Australia to England. When the trade was first established, the owners of the Victoria Docks in London prepared chambers which were cooled by ammonia machines sufficient to hold 3,200 carcasses. There were four chambers of 12,000 cubic feet each, supplied by a ten horse-power engine, delivering 10,000 cubic feet of air below the freezing-point per hour. There are now on the Royal Victoria Docks sixty chambers of 240,000 cubic feet capacity, supplied with 370,000 cubic feet of air below the freezing-point each hour, by a three hundred and twenty horse-power engine. These chambers will hold 80,000 carcasses of mutton at one time.

I lately put a very commonplace question to the F. W. Wolf Company, of Chicago, manufacturers of freezing machinery. I asked them, as if it were an every-day ordinary matter of business, at what price they would put down an ammonia plant suitable for maintaining the temperature of a cotton-mill three hundred feet long, one hundred feet wide, twelve-foot post, four stories

high, at a uniform degree of 70° Fahr. throughout the summer. To which they replied:

"Yours of the 9th instant is at hand. We can furnish you one of our No. 5 Linde refrigerating machines, having a capacity equal to the melting of twenty-five tons of ice in twenty-four hours" (this is the standard of the effectiveness of this machinery).

"With this machine the temperature of a spinning-mill of the size given may easily be kept at 70° Fahr. We will furnish the whole plant, including the necessary cold-air pipes, ventilators, etc., for the sum of fifteen thousand dollars."

I have written to them to know what would be the cost of operating this machine.

Cotton manufacturers may yet be obliged to convert their mills into sanitariums, to which they may attract, not perhaps the most attractive women of the land, but those most capable of being attracted by attractive conditions of work, by offering them the most equable and pleasant temperature, most conducive to health, which they can find in any occupation open to them. This will only be in the line of all the other improvements which have been made in mill operation.

All progress consists in alleviating the noxious and arduous conditions of labor, in enabling the workmen to increase the product with lessening effort, in shortening the hours of labor, in raising the rate of wages, and in reducing the cost of production. In this line of progress there is room and to spare for us all. We of the North may retain what we possess and we may continue to gain in the finer branches of the textile arts. At the same time we may welcome our Southern friends in their effort to supply themselves and to share the wider markets of the world, which may soon be open to us by the removal of the duties on the crude or partly manufactured materials which are necessary in the construction of our factories and in the processes of our industry.

I am conscious that I have covered too much ground. My time does not suffice for condensing what I have to say. I have given my manufacturing friends an optimistic view of the future of cotton-spinning in this country. Bear in mind that for any immediate application these figures are all rubbish. There is at the moment an overstock of Southern goods, and apparently an oversupply of heavy goods and of colored goods in the North as well. Therefore, unless they act upon old Billy Gray's principle of moving against the evidence, and operating always when appearances are most adverse, they will conclude that, although we may require five million spindles in the next ten years, the man who puts in a foundation next year may make a great blunder.

I have ventured to suggest to the promoters of the Exhibition

of 1893 that a considerable part of that undertaking shall be devoted to object-lessons in the development of the arts of life, taking as my example spinning and weaving. The distaff, used as it was in the days of Homer, may still be found in use in northern Italy. The hand loom and the spinning-wheel of prehistoric type are presented in these pictures from China. Other methods of spinning, and other wholly different forms of hand loom carried in the hand for weaving narrow stripes, may be brought from central Africa, and so the whole history of the textile arts may be gathered in one place, either by obtaining examples from different parts of the world, or any one may study the whole development of the cotton manufacture if, before it is too late, he will visit the heart of the eastern Kentucky mountains, and from there journey by way of the neighborhood mills of the South to the great factories of the North.

PUBLIC SCHOOLS AS AFFECTING CRIME AND VICE.

By BENJAMIN REECE.

THE political and material progress of the nineteenth century have been truly wonderful. The past year was memorable as the anniversary of the inauguration of the first President of this great republic, and what a record of bewildering changes do those hundred years unfold! Thirteen States have been increased to forty-four, and the center of population has moved back from the seaboard to a point nearly a thousand miles in the interior. The lakes of the North have given birth to gigantic commercial marts, which rival in trade, wealth, and culture those seats of ancient pomp, and empires and cities of mediæval grandeur, which flourished on the shores of the Mediterranean.

The affairs of the remotest portions of this immense domain, together with the world's more notable events, are regularly recorded in the daily press and read the morning following at the breakfast table. The traveler boards the train at New York, having telegraphed his friend in Chicago to meet him at the station twenty-four hours later, giving the exact minute of his arrival at a place a thousand miles distant from his starting-point. A change of cars is made for San Francisco, and after riding over hundreds of miles of fertile prairie covered with growing crops, crossing wide rivers spanned by bridges which fifty years ago were deemed impossible, across boundless plains where countless herds of cattle and flocks of sheep are fed, and passing through vast mountain ranges pierced by tunneled passage-ways, the traveler reaches his destination upon the shores of

the Pacific Ocean the very minute of the day announced to him by the ticket agent in New York.

If we turn our thoughts seaward the development is no less remarkable; for the long, dangerous, and uncertain voyages once made by sail to Europe are now conducted with almost equal regularity and safety, and the mammoth steamers of the Clyde accomplish in days the trips which formerly took months to perform, and, within an hour of the safe landing of the passengers, the electric telegraph through the media of lines and ocean cables discloses to friends at home the news of their safe arrival. In the political world the progress of the century has not been less marked. England, which during the reign of George III so persisted in tyrannical measures of taxation as to push its American colonies into a successful struggle for freedom, has extended the utmost liberty of action to its remaining American dependencies and Australian colonies; so, when Britain was threatened with hostilities in the East, she moved to the scene of action the dusky warriors of her Indian empire, while the impetuous youth of her distant colonies volunteered to do her service on the desert sands of Africa or in the mountain fastnesses of Asiatic Russia. Within a generation has been witnessed the voluntary liberation of the serfs of Russia, the slaves of Cuba and South America, and in our own country chattel slavery was forever extinguished by the sword.

The growth of liberal ideas and the love of liberty have been very marked. Hungary has been granted the right to legislate upon its own affairs; a republic has been established in France, and in spite of dire forebodings and prophecies of evil it has withstood every shock and weathered every storm; while the greatest of English parliamentary leaders, in his declining years exhibiting all the ardor of youth, combined with the vigor of robust manhood and the matured wisdom of old age, has brought his fellow countrymen to a recognition of Ireland's wrongs, and is moving the English masses to extend the principles of Anglo-Saxon liberty and home rule to Ireland, which for centuries has been inthralled. But volumes would be required for the mere enumeration of the growth and development which have come with extended knowledge and the more general schooling of the people. Is it any wonder that statesmen unstintingly provide for the wants of our public schools; that divines dwell with rapture upon the blessings they have brought us; that political orators eulogize them as the foundation of our prosperity and the mainstays of our liberties; that agitators vehemently demand an extension of their benefits; or that the people feel an honest and unquestioning pride in this governmental institution of their own creation, which has promoted religious tolerance, extended the

bounds of political liberty, enhanced the nation's wealth, and contributed so largely to its power?

It, however, is further claimed, and almost universally allowed, that the instruction of our public schools serves to ennoble the emotions and to moderate the passions, to regenerate the viciously inclined, and to correct and subdue the tendency to crime. Devoutly as such a result is to be desired, the facts unhappily flatly contradict the theory, and unless the glaring inconsistencies are reconciled, and contravening evidence is satisfactorily explained, the claim must be abandoned as unfounded.

At a session of the National Prison Congress, held in Boston during 1888, Mr. Brooker, chairman of the Board of Directors of the South Carolina Penitentiary, having made the statement that of a thousand convicts in the State not more than fifty were whites, it was asked by a delegate, "What is the condition of the education of the colored people?" To this question Mr. Brooker made the following reply: "Before emancipation, the colored people had no opportunity for education. When made suddenly free, all negroes were illiterate and ignorant. Since that time a young generation has grown up, and of them a very considerable number are well educated. *But it is a fearful fact that a large proportion of our prison population is of the educated class.* This is so much the case that the idea has become prevalent that to educate the negro is to make him a rascal. But this idea is of course superficial, and does not find lodgment in the minds of thoughtful men. I am totally averse to it myself, and think that all reasonable means should be exerted toward their enlightenment and education." ("Proceedings of the National Prison Association," 1888, p. 72.)

The constructing engineer is to our industrial, commercial, and mechanical development all that the statesman and student of sociology is to our moral, social, and political progress. If in a convention of engineers a verified report had been made that bridges of accepted form were showing visible signs of weakness, the report would have been listened to with the greatest consternation and dismay. The convention would have instituted the closest inquiry and most searching examinations; it would have stopped the construction of such bridges until the causes of failure had been determined and the remedy ascertained, and failing in this the construction of such bridges would have been permanently abandoned and more perfect structures substituted.

But here was the most astounding fact that in South Carolina, which in 1880 had more than half its population returned as illiterate, the educated negroes furnished a large proportion of its criminals, pressed upon a representative body of philanthropists, publicists, and statesmen, and it did not so much as provoke

a comment, while the author of the statement boldly affirmed his unshaken faith in a theory the facts of which he had himself impugned. What deference should we pay to thought unless based upon correct observations, and of what utility are facts and experiences unless their teachings are heeded and their meaning properly interpreted?

In his "Political Science" Woolsey tells us that "the fall of the Roman Empire was an effect of a moral ruin." Yet all will admit that Rome and the other civilizations of antiquity were richer and more learned in the time of their decay than during the period of their infancy and growth; but the moral correlative being wanting, they tottered to their fall.

Just look at the records of our mentally and morally deranged as exhibited in our statistics of insanity and crime and vice, and they alone are enough to cast doubt upon the claim that a public-school education for our illiterates is sufficient to insure a decrease of mental and moral delinquency. For it remains to be explained why, in the decade ending with 1880, population having increased thirty per cent and illiteracy only ten per cent, a relative decrease; that the number of criminals during the same period present the alarming increase of eighty-two per cent, while of insane persons there appears the enormous addition of one hundred and forty-five* per cent?

Can it be possible that with greater educational facilities there is to be increased crime, and that every enlargement in the seating capacity of our schools is to be followed by a larger corresponding demand for insane accommodations, and additional felons' cells? Perish the thought! Yet if the instruction of our common schools subdues the tendency to crime, why is it that the ratio of prisoners,† being one in 3,442 inhabitants in 1850, rose to one in every 1,647 in 1860, one in 1,021 in 1870, and one in 837 in 1880; while, upon the authority of the Rev. S. W. Dicke, the amount of liquor consumed per capita was three times as great in 1883 as in 1840?

One naturally looks to the large and constant influx of foreign immigrants as a partial explanation of this growing disproportionate increase of crime; but the facts deny the hope, for the great increase is to be found among the native-born. The Rev. F. H. Wines, who conducted this branch of the "Tenth Census Report," says that, while in 1850 the ratio of foreign criminals to population was five times that of the native-born, in 1880 the

* It is but fair to state that this enormous increase of insanity has led the compiler to question the accuracy of the returns of insane persons made in 1870, yet it is admitted that, after making every allowance, the ratio of increase is out of all proportion to that of population. (See page 1660, "Compendium of the Tenth Census.")

† "Proceedings of the National Prison Congress," 1886, p. 134.

ratio was only two to one; and if we deduct the commitments for disorder and immorality, the ratio of foreign criminals is but little in excess of that for native whites. So clearly is this indicated by facts and figures, that Mr. Wines arrives at the conclusion that "the foreign disregard for law shows itself far more in immorality and disorder than in dishonesty and violence."*

An examination of the "Compendium of the Tenth Census" of the United States discloses some novel and threatening facts. The illiterates of the United States comprise seventeen per cent of the total population. The morally and mentally deranged, as shown by the number of criminal and insane persons, bear the ratio of one to every 332 inhabitants. The general average of illiteracy is exceeded by every one of the original slave States with the exception of Missouri, but the average ratio of the mentally and morally unsound is only reached in the State of Maryland. South Carolina, which shows the highest percentage of illiterates, viz., $55\frac{4}{10}$ per cent, presents the lowest average of any State in the Union as regards insanity and crime, having but one delinquent in every 568 inhabitants as compared with one in every 167 in California, one in 205 in Massachusetts, and one in every 222 in the State of New York. With the single exception of the State of Maine, every Northern State east of Indiana has a larger ratio of insane and criminals than the average for the Union, while the States west of Ohio, those on the Pacific slope excepted, fall below the general average.

If we measure the extent of unrecorded vice by the proportion of saloons to population, the showing is no less remarkable. The "Report of the Commissioner of Internal Revenue for the Year 1887," page xxxiii, shows that, for the entire country during that year, a retail license for selling liquor was granted for every 329 inhabitants. Of the fifteen States showing more than the average number of illiterates that ratio was only exceeded in the State of Louisiana; while the lowest average in the country was to be found in Mississippi, which, with $49\frac{4}{10}$ per cent of its inhabitants returned in 1880 as being illiterate, supported but one saloon for every 1,695 persons. Even the prohibition States of Maine and Kansas secured licenses for the sale of intoxicants at retail to an extent only equaled by four of the fifteen super-illiterate States. The proportion of saloons to population throughout the fifteen super-illiterate States is one for every 700 inhabitants, while of the other States California heads the list with one to every 99 persons, New Jersey coming next with one license to every 171 inhabitants, followed closely by New York with one to every 179.

The table which follows presents some disquieting facts, which

* "Proceedings of the National Prison Association," 1888, p. 255.

should serve as a salutary warning to those who expect to find in mental stimulation an equivalent for moral growth and culture:

Compiled from Compendium of Tenth Census, and other official sources.

	Illiterates ten years of age and over.	Assessed valuation per capita.	Ratio of insane and criminal.	Ratio of saloons to population.‡
	1880.†	1880.†	1880.†	1887.
	Percentage.	Amt. per capita.		
Fifteen illiterate States*.....	40 1/10	$145	1 in 402	1 in 700
Northern States west of Ohio .	7	297	1 in 379	1 in 308
Northern States east of Indiana.	5 1/10	551	1 in 265	1 in 227
Average	17	$340	1 in 332	1 in 329

The table unmistakably shows a greater per capita of wealth where the fewest illiterates are enumerated, but it no less clearly shows that this augmentation of riches has been accompanied by increased insanity and crime and more wide-spread vice.

But we need not confine ourselves to the general statistics of the United States, for the records of New York present similar conditions, which can be analyzed more in detail. The "Annual Report of the Superintendent of the New York State Prisons, 1886," records that the prisons of Auburn and Sing Sing contained 2,616 convicts; of these, 1,801 are credited with a common-school education, 373 are classed as being able to read and write, 19 are returned as collegiates, 10 as having received classical and 78 academic educations, 97 as being able to read only, and 238 as having no education. Is it not contrary to our most confident predictions and undoubted expectations that the common schools should furnish eighty-three per cent and the colleges and academies over four per cent of the inmates of Auburn and Sing Sing?*

When it is remembered that the detected illiterate generally finds his way to prison, while the highly educated or well-to-do are frequently saved by friends, who compound the felony to escape exposure and consequent family disgrace; that many are saved from conviction by the ability of counsel whose services are far beyond the means of the illiterate poor, while still many others escape into voluntary exile to avoid imprisonment, it will be seen that even the figures given inadequately portray the extent of crime which, in strict justice, is properly chargeable to the educated classes. Of the prisoners of Auburn and Sing Sing it

* Includes all States having a percentage of illiteracy above seventeen per cent, the average for the entire country.

† Computed from tables in Compendium of the Tenth Census.

‡ Retail licenses issued by United States in 1887, taken from Report of Internal Revenue Commissioner. Population for 1887 from "World Almanac," 1888.

* The report for Clinton Prison simply classified the prisoners received during the year, and it could not be included with Auburn and Sing Sing, which classify all inmates.

is further noted that twenty per cent were total abstainers from intoxicants, showing very clearly that a perfect mastery of self is by no means necessarily allied with an honest regard for the rights and property of others.

But if the education of the masses is accompanied by no diminution of vice, crime, and insanity, what shall we say of the effect illiteracy may have upon our institutions by the abuse or misuse of the suffrage? The following extract from the address of the Rev. J. C. Hartzall, delivered before the National Education Assembly at Ocean Grove, in August, 1885, which, with other extracts, is incorporated in the speech of Senator Blair on his Educational Bill, delivered in the Senate, February 8, 1886, presents a fair example of the rather extravagant statements often made by publicists and statesmen concerning the dangers attending the exercise of the elective franchise by illiterate voters. The reverend doctor thus appealed to the Assembly: "I simply call your attention to what may be the injurious effect of their (illiterates) silent action at the polls. The members of our respective political parties believe in the rightness of their principles, and seek to make their appeal to the reason and the consciences of the people; but the figures disclose the alarming fact that in eleven States these illiterate voters outnumber the votes cast in the last presidential (1884) election by either of the political parties. Thus, should they unite under any strong, impassioned, successful leader, they would have absolute control of legislation and offices in those States, and of the election of twenty-two members of the United States Senate."

Only a moment's thought is necessary to expose the folly of such ill-founded fears, for the suggested peril is contravened by the very conditions set forth as dangerous, as the inability to read and write affords a complete and absolute bar against the possibility of such concerted action; for what means of communication are to be employed to unite, for a single purpose, the illiterates of eleven States, who can neither read letters, circulars, documents, nor newspapers, and, still further, are unable to write answers in return? It requires the most perfect organization, careful canvass, and the expenditure of vast sums of money, to bring out a full vote where conditions are the most favorable for it, in the enlightened and thickly settled portions of the Union, and only where States are very evenly divided is the organization so perfected, at great cost, as to make a full vote possible.

But the election returns themselves are sufficient to prove that the voters in the illiterate States adhere more closely to the two great parties which are said to "appeal to the reason and consciences of men" than do the voters of the States affording the best facilities for the education of the masses; and in the election

referred to in the address, the fifteen super-illiterate States combined cast but twenty-five per cent of the Greenback vote polled by the single State of Michigan, while in the late presidential election the same fifteen States cast but ten per cent more Labor-Union votes than were cast in the State of Kansas alone, and nine of the super-illiterate States fail to record the polling of a Union-Labor vote.

Far from mental stimulation being essential to moral development, the most perfect order and deepest sense of justice are often found associated with the densest ignorance among the lowest races of humanity. Turn your attention to the Papuan-Islanders,* the Veddahs,† the Dyaks of Borneo,‡ the Fuegians,* and other barbarous races which, in the absence of rulers or organized societies, with no learning and but little acquaintance with even the rude arts of many primitive people, have developed the highest degree of tribal piety, integrity, chastity, and regard for covenants almost unknown to civilized man. The testimony of early travelers proves conclusively that intense poverty and deep ignorance are by no means incompatible with honesty, integrity, and virtue.

The table shows that where the extremes of poverty and wealth prevail, as in the Eastern States, there is found a maximum of moral and mental derangement, as exhibited in insanity, crime, and vice. Where wealth is more evenly distributed, as in the Western States, there are noted less insanity and crime, but almost as high a ratio of saloons as in the East. In the Southern States, although having a low per capita of wealth, yet the mental and moral forces of development are more nearly in adjust-

* "It is worthy of remark that these simple islanders, without hope of reward or fear of future punishment after death, live in such peace and brotherly love with one another, and that they recognize the right of property in the fullest sense of the word, without there being any authority among them other than the decision of their elders, according to the customs of their forefathers, which are held in the highest regard." (Earl Kolff's "Voyages of the Dogma," p. 161.)

† "The Rock Veddahs are divided into small clans, or families, associated for relationship, who agree, partitioning the forests among themselves for hunting-grounds, the limits of each family's possession being marked by streams, hills, rocks, or some well-known trees, and these conventional allotments are always honorably recognized and mutually preserved from violation. Each party has a head man, the most energetic senior of the tribe, but who exercises no authority except distributing at a particular season the honey captured by the members of the clan." (Tennant, ii, p. 440.)

‡ "The Dyaks' minds are as healthy as their bodies; theft, brawling, and adultery are unknown to them." (Boyle's "Borneo," p. 335.)

"The Dyaks are manly, hospitable, honest, kindly, and humane to a degree which might well shame ourselves." (Ibid, p. 215.)

* "Nothing like a chief could be made out among the Fuegians of Blunder Cove, nor did they seem to require one for the peace of their society, for their behavior one to another was most affectionate, and all property seemed to be possessed in common." (Weddell's "Voyages toward the South Pole," p. 168.)

ment with the material environment; hence the average of crime and vice is shown by the table to be relatively low.

The Rev. F. H. Wines, statistician and philanthropist, who has made questions of crime and criminals the study of a lifetime, was selected by the authorities at Washington to compile the statistics bearing on delinquents in the tenth census; and after a careful study of the mass of figures returned, but few of which appear in the compendium, he makes this very remarkable statement concerning the facts collected and enumerated: "If a comparison is made between offenses against public morals and against public peace, the smallest amount of disorder and the largest of immorality, relatively, are found among the native whites, the most disorder and least immorality among the negroes; and the foreigners occupy a middle ground between the two." ("American Prisons in the Tenth Census," "Proceedings of the National Prison Association for 1888," p. 268.) When it is realized that the native whites represent the better educated portion of our population, and the negroes the more illiterate, while the foreigners are on an educational scale between the two, the significance of the statement can neither be gainsaid nor belittled.

We are, then, confronted by facts which reveal a condition of decreasing illiteracy and increasing crime, of augmenting wealth with more wide-spread destitution. While inventors and engineers have united continents by steamship lines and cables, States by telegraph and railway lines, and cities by bridges, statesmen have vainly sought to unite the interests of employers and employés, of railway managers and shippers, of producers and consumers; and every legislative measure intended to harmonize the interests of these conflicting elements has given rise to greater irritation and more complicated evils.

Since the record of material progress and mechanical construction has been one of unvarying certainty and triumph, while legislation has so often led to failure in the investigation of this educational problem, will it not be well to reject the hap-hazard devices of the legislator, and confine ourselves to the scientific methods so successfully employed by the constructing engineer and mechanical inventor? Take, for illustration, the history of Bessemer steel railway-bars. The introduction and use of these bars for our railway-tracks so cheapened the cost of transportation that it made possible the development of the far Western States and Territories, which find themselves enabled to profitably market produce thousands of miles away.

Twenty years ago, under a traffic which constituted but a small fraction of the mileage which the same roads are performing to-day, iron rails became worn down and laminated with such rapidity that the cost of track repairs was enormous, and it

was by no means uncommon for iron rails to be removed from the track worn out before they had been subjected to a single season's wear. About that time the Bessemer steel rail was introduced, and its hard, homogeneous metal offered great resistance to the wear and abrasion of the rolling wheels. But a new difficulty appeared; for, while the steel rails suffered but little from wear, they developed a provoking tendency to break without giving any previous warning, which served to increase the danger of railroad traveling. Upon the discovery of this evil, the engineers in charge neither discarded the Bessemer rails, nor did they close their eyes to its obvious defects, but, in imitation of our social concerns, they kept acurate statistics of the life and breakage of the rails, and finally discovered that, in the effort to resist the tendency to wear, they had gone so far as to make the metal brittle; hence the saving to wear was partly lost because of the failure of rails by breaking. Less carbon was put into the steel, and a softer metal was produced, which, while vastly superior to iron as against lamination and abrasion, was sufficiently soft to avoid the breaking, with its attendant dangers.

Do not the facts disclosed by our social statistics cause it to appear that, in the adjustment of our schools, we have gone too far in our aim for material advancement and development of wealth, and that we are correspondingly losing in the direction of moral growth and culture? Let us, then, imitate the prudence of the railway engineer, and, though seeking to retain the advantages which are already ours, let us not be blind to the visible defects and besetting dangers of our present system. Let us determine the composition of the training of our public schools; let us see if its parts are well proportioned and the compound skillfully wrought, and a thorough analysis may prove, as with the Bessemer steel rail, that, by a judicious change in the nature or proportion of the ingredients, our rapid increase of wealth may suffer a trifling diminution, but the moral balance of education will be restored, and material, political, and moral progress will move forward together.

In his presidential address to the Royal Geographical Society, President Strachey, assuming that the last barrier excluding us from unknown regions would soon be broken through, named the establishment of the supremacy of modern civilization and progress over Africa as the next geographical problem. That continent presents wholly different conditions from any other land that has been brought under civilization, and will call for different methods of management. It can not be directly colonized, as were North America and Australia, or administered as India is; and amalgamation between European settlers and the indigenous races is wholly out of the question. The operation will necessarily be a long and, in some respects, a painful one.

THE TAOUIST RELIGION.

By WARREN G. BENTON.

IN an attempt to unravel the mysteries of the religions of the Chinese, one is confused at the outset by the almost obliterated lines between the three leading forms of religion existing side by side. The process of amalgamation has gone on for so many centuries that one is liable to be misled in an effort to analyze the different creeds. The fact is that Buddhism, Taouism, and Confucianism have existed in the same minds until a belief in the distinctive phases of each has become quite common. And even those who nominally accept the Christian religion, either Catholic or Protestant, really add the new to the old faiths, and believe more or less in the four religions. It is thus true that in one mind may be found a belief in four primarily distinct and separate religions—each having added its quota toward a result whose aggregate beliefs are derived from wholly dissimilar sources; and the result is, as might be looked for, a unique specimen of religionist.

In this paper I shall endeavor to indicate the particular features of Taouism.

This system of religion is pronounced indigenous to China. Its founder was one Laou-tse, who is supposed to have lived contemporary with Confucius, and to have been some years older than that celebrated philosopher. The word *Taou* signifies *reason*, and therefore a *Taouist* is a *rationalist*, in name at least; but, in *fact*, the Taouists are the most *irrational* of all the religionists of the East.

The tendency in rationalism is toward the utter destruction of belief in the existence of unseen spirits of evil. Enlightened reason dethrones devils; but Laou-tse created devils innumerable, and the chief concern of the Taouist sect has always been to manipulate these emissaries of evil. Modern rationalists deny the existence of devils, and relegate them to the category of myths and to personified ideas.

Not so the rationalist of the Orient. He finds his greatest pleasure in contemplating the very atmosphere he breathes as filled with spirits constantly seeking his injury; and to outwit his satanic majesty is the chief end of life.

The sect is founded on the monarchic plan. The chief high priest corresponds to the Pope in the Catholic religion, and all authority is vested in him. His decrees constitute the laws of the sect, and all power to perform miracles must come from him to the priesthood. He has the power to exorcise devils and to heal

the sick and avert calamities, and this power he delegates to such of the priesthood as command his favor. Such delegated power, however, is held on sufferance, and not in fee-simple. It is not only necessary that a priest gain favor with his royal highness to get this power, but he must retain said favor in order to hold the power. This has created a vast army of priests, who are the willing tools of the high priest; and he is thus enabled to wield the most absolute and despotic sway over the minds of the people.

The system has the most elaborated code of demonology, and it is likewise patterned after the political constitution of the empire. The head devil lives in the sea, and has been honored by the Chinese people by being adopted as their national emblem. The dragon flag, which floats from every staff, from the dome of the royal palace at Pekin to the mast-head of the humblest Chinese boat, testifies to the high esteem in which the chief devil of Laou-tse's followers is held. Then the multitude of lesser devils is so great that no man can number them; and these are on the track of every man, woman, and child, seeking in all methods their injury. To watch the movements of this devil host, and to frustrate their designs, is the province of the Taouist priests.

Here we have a decidedly interesting state of things. The very earth teeming with malicious demons! Man everywhere exposed to their attacks, and but one avenue of escape, viz., through the interventions of the priests! Is it a matter of surprise, therefore, that this priesthood wields such absolute power over the minds of the people? They live on the fat of the land. They are consulted on all occasions, and their instructions are obeyed to the letter by their deluded followers. It is not to be wondered at that these priests look with disfavor upon the advent of Europeans; that they fill the minds of the people with such antipathy to all change from the established order. They are wise enough to forecast their own overthrow with the advent of a deeper intelligence.

The priests are celibates, perhaps with the thought that, if they were to prove unequal to the task of managing a wife, their prestige in devil manipulation might suffer. They keep aloof from the common life around them and live in mountains and unfrequented and isolated places, that they may the better impress their own superiority over their fellows.

The priests are called upon by the people when it is discovered that a home or village is infested by a devil. Devils have the power to materialize themselves into a piece of waste paper or dirt in order to get into the houses unobserved. These devils are not credited with a high order of intelligence. Chinese architecture is governed by this conception. The doors or main entrances are put in unexpected angles and niches in the walls, with

the idea that they will fool the devils. They cut up the roof-lines on dwellings into fantastic shapes for the purpose of preventing devils using them for promenade purposes; and, as a matter of fact, these imps have hard work to get into the houses. But, when they once get in, no power is able to get them out except the priests.

The white horse is a common form in which devils infest a community. They appear in the form of a white horse walking upon the city walls, and over graveyards, and even stepping from one roof to another. He is thus seen by some truthful witness, and the evil omen soon gains currency.

The intervention of the nearest priest is sought, who takes a survey of the situation, and discovers the number of devils, if more than one, and calculates on the necessary steps to capture it or them.

The financial ability of the community has much to do in determining the means of safety. If the locality is wealthy, or has a few wealthy men in it, the priest generally makes out a strong case. He may require to call in other priests in consultation. All this time the people dwell in morbid fear, pending deliverance. At length the priests announce their ultimatum. It will require a fee of one hundred taels (about one hundred and thirty-three dollars, American money) to procure safety. The money is raised by public subscription and paid over to the priest in charge. Then the capture of the devils is the next step.

A bottle or jar is secured for each devil, and the priests secure a bait in the shape of imitation gold and silver tinted paper (called Joss paper). This paper is imitation money, and when it is reduced to spirit by being burned, the devils do not know it from genuine money—here again showing their low mentality—and they enter the bottle in which the Joss paper has been burned. When they are thus entrapped, the bottle is sealed and carried away by the priest. Then the people feel grateful to their deliverer, and the priest has again impressed his importance to the welfare of the community and at the same time replenished his bank account. The "Tsung li Yamen," or office of the head priest of this sect, is a curiosity. It has large halls and rooms filled with dust-covered and sealed jars, in every one of which is confined a devil, captured in the above unique plan. And were each and every jar filled with silver, I question if it would equal the sums paid for the capture of these imprisoned devils.

This demonology enters into every phase of Chinese life. The priest is the only medium between the people and their invisible foe. Not a voyage is undertaken until the devils are baited by burning bogus paper money. Not a wedding, but the priest is called in to decipher the omens for good or ill luck. And when a man is sick,

he is possessed of devils. Chills are the most common form of possession. What makes a man shake if he is not in the power of a devil? So the people believe, and a priest is called instead of a doctor, and prayers take the place of pills. Epileptic fits or convulsions are the devil in a malignant form; and if a man is taken thus in a crowded building, that building is rapidly deserted.

A good doctor could go among the Chinese and, by curing the sick, attending his physic by incantations, enthrone himself as a deity in the belief of that deluded people. When a man is dying, no money would induce a Chinaman to remain near him. I first met this fact on a Pacific steamer bound from San Francisco to Hong-Kong. I was walking on the deck with the ship's surgeon, when a stream of Chinamen came rushing on deck from the lower decks like a colony of ants when disturbed. I asked what had caused such a stampede. The doctor replied that a Chinaman was dying. He hurried below, and found a man gasping his last breath, with consumption. I discovered later, when pursuing my studies of Chinese religions, the secret of this strange stampede. The devil was after the soul of that poor consumptive, and the rest were not going to take any chances by remaining near him in the final struggle.

Not every wise-looking magpie or crow, which alights upon the bough of a tree to rest, is the innocent creature it appears to be; but a devil in disguise spying out the lay of the land. Nor do the frightened people seek relief by killing the bird of evil omen, but they call a priest to look into the matter. He generally advises that the tree be cut down in the night and removed.

Thus, when the devil, *alias* a magpie, returns to his perch, he is fooled, and thus thrown off the track.

The ceremonies so often observed on occasions of death all have their origin in the demonology of the Taouists. Paper suits, paper palaces, paper pipes and money are burned when a man dies, to provide the soul of the dead with means of bribing its way through the devil's kingdom to its rest, and the suits burned are often patterned after high officials' gowns, in order to impress more favorably the spirits encountered on the mysterious journey.

Taouist priests are called to consult the soul of the departed to ascertain its wishes. They discover the locality for burial, and indicate all details of this last service to the dead.

The Shanghai Railroad met its doom from this source. The priests informed the people that the rumbling noise of the cars and the steam-engine were distasteful to the dead who filled the numerous mounds along its course. To appease the wrath of the dead, Chinese capitalists bought the road with its equipments,

and tore up the tracks and stored the entire plant under sheds at Shanghai. Thus it is seen that this religion stands in the way of all innovations in that old country, and the first thing necessary in order to introduce railroads into China is to dethrone the priests and infuse a little common sense into the people.

Since this last paragraph was written, this point has had a characteristic demonstration. Through the influence of Li Hung Chang, the most intelligent and progressive Chinaman, and one or two other high officials, the emperor was prevailed upon to grant the construction of a railroad from Hankow to Pekin. Not many days had elapsed after the permit was given until the Temple of Heaven at Pekin was burned, and floods came in the Yellow and Yang-tse River Valleys, which were interpreted to have been indications of the disapproval of the proposed innovation on the part of spirits or the Taouist devil; and the press dispatches announce that the emperor has taken the timely warning and revoked his sanction of the proposed railroad. Any one having to make the journey between the two objective points of the proposed road will save time by starting on foot, or going around *via* Shanghai by water. Otherwise he is liable to have a long time to wait for the completion of the road.

During the prevalence of the great famine in northwestern China in 1874–'78 there was an unusual flood in the valley of the Yang-tse-Kiang. The priests endeavored to solve the mystery of this uneven distribution of rain. The censure fell upon the royal household at Pekin. It is the duty of the emperor to enter the Temple of Heaven twice a year and invoke the blessings of Heaven upon the people. He always asks for rain among other things, and the impression obtained that the emperor had hurriedly asked for rain, but had not taken the pains to state where he wanted it. The result was that floods came in some places, while famine from drought came in other parts of the empire. This feeling was producing a general spirit of revolt, when in 1878 the rains came to the rescue in the drought-smitten provinces.

At this time I had a conversation with a merchant at Shanghai on the subject. He exhibited an independence of thought which was exceptional. But it showed a tendency toward the inevitable break from the tyrannical rule of ignorance and superstition which must eventually come to awaken an age of reason. And when it comes, the Taouist high priest must fold his tent and silently march away.

The merchant said, "Chinaman, he all time chin, chin" (meaning that they resort to prayers and other priestly methods in time of calamity), "while Melican man, he build more stout walls to keep water back."

Thus had one man concluded that substantial sea-walls and

dikes were more availing in times of flood than prayers as a protection from encroaching waters from overflowing rivers.

But the dominance of ignorance and the quackery of priests will hold China in slavery to an unreasoning fear and irrational faith for generations yet unborn. Yet the seeds of a better intelligence are being planted in this dark corner of the earth. The people observe that Europeans give no heed to imaginary devils, and still they prosper without the intervention of priests; and thus will eventually dawn upon them how grievously their forefathers have been hoodwinked, cheated, and robbed by the reign of demonology, created and perpetuated for their own gain by the army of Taouist priests.

LETTERS ON THE LAND QUESTION.

By HERBERT SPENCER, FREDERICK GREENWOOD, Professor HUXLEY, Sir LOUIS MALLET, and JOHN LAIDLER.

THE following letters, reprinted from the London "Times" of recent dates (from November 7 to 15, 1889), are of great interest on account of the light they throw upon some of the more important aspects of the question of land nationalization, and on the problems of socialism in general.—EDITOR.]

MR. SPENCER'S FIRST LETTER.

To the Editor of "The Times":

SIR: During the interview between Mr. Morley and some of his constituents, reported in your issue of the 5th inst., I was referred to as having set forth certain opinions respecting land-ownership.* Fearing that, if I remain silent, many will suppose I

* *Extract from the Morley Interview.*

MR. LAIDLER said their method of dealing with the land would be that the present owners should hold it for their time, and that it should revert back to the State. They remembered that Mr. Herbert Spencer had said that the land had been taken by force and by fraud. That gentleman had also said that to right one wrong it takes another.

MR. MORLEY.—Has Mr. Spencer said this?

MR. LAIDLER.—Yes; we all know.

MR. MORLEY.—You are aware that he has recalled some of the things he has laid down?

MR. LAIDLER.—If he has stated truth and recalled it, the truth will prevail.

MR. MORLEY.—Do you include houses?

MR. LAIDLER.—We include land, not houses. In houses there is labor, but in land there is not.

MR. MORLEY.—Not?

MR. LAIDLER.—There may be labor exerted in land, but as far as the labor is in the land we believe it ought to belong to the laborer. As the land has been obtained by the method I have named—by force and fraud, as Spencer says—we contend that the land ought to be taken back by the community and handed over to the municipalities and county councils to be used in such democratic manner as the people may elect those bodies for.

MR. MORLEY.—I can not think that what is commonly called nationalization of the land

have said things which I have not said, I find it needful to say something in explanation.

Already within these few years I have twice pointed out that these opinions (made to appear by those who have circulated them widely different from what they really are, by the omission of accompanying opinions) were set forth in my first work, published forty years ago; and that, for the last twelve or fifteen years, I have refrained from issuing new editions of that work and have interdicted translations, because, though I still adhere to its general principles, I dissent from some of the deductions.

The work referred to—"Social Statics"—was intended to be a system of political ethics—absolute political ethics, or that which ought to be, as distinguished from relative political ethics, or that which is at present the nearest practicable approach to it. The conclusion reached concerning land-ownership was reached while seeking a valid basis for the right of property: the basis assigned by Locke appearing to me invalid. It was argued that a satisfactory ethical warrant for private ownership could arise only by contract between the community, as original owner of the inhabited area, and individual members, who became tenants, agreeing to pay certain portions of the produce, or its equivalent in money, in consideration of recognized claims to the rest. And in the course of the argument it was pointed out that such a view of land-ownership is congruous with existing legal theory and practice; since in law every land-owner is held to be a tenant of the Crown—that is, of the community, and since, in practice, the supreme right of the community is asserted by every Act of Parliament which, with a view to public advantage, directly or by proxy takes possession of land after making due compensation.

All this was said in the belief that the questions raised were not likely to come to the front in our time or for many generations; but, assuming that they would some time come to the front, it was said that, supposing the community should assert overtly the supreme right which is now tacitly asserted, the business of compensation of land-owners would be a complicated one:

> One that perhaps can not be settled in a strictly equitable manner. . . . Most of our present land-owners are men who have, either mediately or immediately, either by their own acts or by the acts of their ancestors, given for their estates equivalents of honestly earned wealth, believing that they were investing their savings in a legitimate manner. To justly estimate and liquidate the claims of such is one of the most intricate problems society will one day have to solve.

To make the position I then took quite clear, it is needful to add that, as shown in a succeeding chapter, the insistence on this

> is anything but what it was called the other day—either robbery or folly. I have really no more to say on that subject.

doctrine, in virtue of which "the right of property obtains a legitimate foundation," had for one of its motives the exclusion of Socialism and Communism, to which I was then as profoundly averse as I am now.

Investigations made during recent years into the various forms of social organization, while writing the "Principles of Sociology," have in part confirmed and in part changed the views published in 1850. Perhaps I may be allowed space for quoting from "Political Institutions" a paragraph showing the revised conclusions arrived at:

At first sight it seems fairly inferable that the absolute ownership of land by private persons must be the ultimate state which industrialism brings about. But though industrialism has thus far tended to individualize possession of land while individualizing all other possession, it may be doubted whether the final stage is at present reached. Ownership established by force does not stand on the same footing as ownership established by contract; and though multiplied sales and purchases, treating the two ownerships in the same way, have tacitly assimilated them, the assimilation may eventually be denied. The analogy furnished by assumed rights of possession over human beings helps us to recognize this possibility. For, while prisoners of war, taken by force and held as property in a vague way (being at first much on a footing with other members of a household), were reduced more definitely to the form of property when the buying and selling of slaves became general; and, while it might centuries ago have been thence inferred that the ownership of man by man was an ownership in course of being permanently established, yet we see that a later stage of civilization, reversing this process, has destroyed ownership of man by man. Similarly, at a stage still more advanced, it may be that private ownership of land will disappear. As that primitive freedom of the individual which existed before war established coercive institutions and personal slavery comes to be re-established as militancy declines, so it seems possible that the primitive ownership of land by the community, which, with the development of coercive institutions, lapsed in large measure or wholly into private ownership, will be revived as industrialism further develops. The *régime* of contract, at present so far extended that the right of property in movables is recognized only as having arisen by exchange of services or products under agreements, or by gift from those who had acquired it under such agreements, may be further extended so far that the products of the soil will be recognized as property only by virtue of agreements between individuals as tenants and the community as land-owner. Even now, among ourselves, private ownership of land is not absolute. In legal theory land-owners are directly or indirectly tenants of the Crown (which in our day is equivalent to the State, or, in other words, the community); and the community from time to time resumes possession after making due compensation. Perhaps the right of the community to the land, thus tacitly asserted, will in time to come be overtly asserted and acted upon after making full allowance for the accumulated value artificially given. . . . There is reason to suspect that, while private possession of things produced by labor will grow even more definite and sacred than at present, the inhabited area, which can not be produced by labor, will eventually be distinguished as something which may not be privately possessed. As the individual, primitively owner of himself, partially or wholly loses ownership of himself during the militant *régime*, but gradually resumes it as the industrial *régime* develops, so possibly the communal

proprietorship of land, partially or wholly merged in the ownership of dominant men during evolution of the militant type, will be resumed as the industrial type becomes fully evolved (pp. 643–646).

The use of the words "possible," "possibly," and "perhaps" in the above extracts shows that I have no positive opinion as to what may hereafter take place. The reason for this state of hesitancy is that I can not see my way toward reconciliation of the ethical requirements with the politico-economical requirements. On the one hand, a condition of things under which the owner of, say, the Scilly Isles might make tenancy of his land conditional upon professing a certain creed or adopting prescribed habits of life, giving notice to quit to any who did not submit, is ethically indefensible. On the other hand, "nationalization of the land," effected after compensation for the artificial value given by cultivation, amounting to the greater part of its value, would entail, in the shape of interest on the required purchase-money, as great a sum as is now paid in rent, and indeed a greater, considering the respective rates of interest on landed property and other property. Add to which, there is no reason to think that the substituted form of administration would be better than the existing form of administration. The belief that land would be better managed by public officials than it is by private owners is a very wild belief.

What the remote future may bring forth there is no saying; but with a humanity anything like that we now know, the implied reorganization would be disastrous.

I am, etc., HERBERT SPENCER.

ATHENÆUM CLUB, *November 6th.*

MR. GREENWOOD'S LETTER.

To the Editor of "The Times":

SIR: Mr. Herbert Spencer's letter in "The Times" of to-day carries with it a heavy lesson to political philosophers. They are taught to remember that this is an age of popular education, as well as of social unrest; that their books are read not only by students like themselves, who often find their chief interest in a display of intellectual subtlety or athleticism, but by thousands of men who are ever on the alert for warranted theories of social reform that will better their condition. And if such theories should happen to be ill-considered before publication, or unaccompanied by a strong and clear recital of whatever reasons are fatal to their application in this work-a-day world, the mischief they may do is enormous. How clearly Mr. Spencer himself must see this now! And how sorry he must be for having so terribly misled, not Mr. Laidler and the Labor party of Newcastle alone—that

is not imaginable—but many other poor men also who habitually hang on the authority of great men like himself.

It was when Mr. Morley was so delicately heckled at Newcastle that a member of the Labor party deputation asked him what he thought about the nationalization of the land. Mr. Morley demurred. Mr. Laidler said the Labor party had its own plan. "They remembered that Mr. Herbert Spencer had said that the land had been taken by force and fraud; that gentleman had also said that to right one wrong it takes another." "Why," replies Mr. Morley, "has he said this?" "We all know he has," rejoins Mr. Laidler. "But you are aware that he has recalled some of the things he has laid down?" "Yes," rejoins Mr. Laidler; "but if he has stated truth and recalled it the truth will prevail." There we are. This little bit of conversation is precious beyond many pages of "absolute political ethics," judged by the standard of usefulness; and it will be useful to nobody so much as to writers like Mr. Herbert Spencer.

For what has he to say to it all? He says that the opinions quoted by Mr. Laidler were set forth forty years ago in a work "intended to be a system of absolute political ethics; or that which ought to be, as distinguished from relative political ethics, or that which is at present the nearest practical approach to it." These opinions were accompanied by others which forbid the interpretation sometimes put upon them. But yet, on reflection, they satisfied Mr. Spencer so little, he thought them so little guarded or corrected by those other opinions of his, that for the last fifteen years he has not allowed the book that contained them to appear in any language. "Though I still adhere to its general principles, I dissent from some of the deductions"—those, perhaps, which Mr. Laidler regards as truth once uttered and never to be recalled. Besides, what Mr. Spencer said on this subject "was said in the belief that the questions raised were not likely to come to the front in our time or for many generations"; and it did include the statement that, if the community took the land, the necessary business of compensation would be a complicated one. "To justly estimate and liquidate the claims" of our present land-owners "is one of the most intricate problems society one day will have to solve." Since "Social Statics" was published, however, Mr. Spencer has come to revised conclusions; and these he now sets forth in "The Times." Permit me to quote a few sentences from this statement:

> Though industrialism has thus far tended to individualize possession of land, while individualizing all other possessions, it may be doubted whether the final stage is at present reached. Ownership established by force does not stand on the same footing as ownership established by contract; and though multiplied sales and purchases treating the two ownerships in the same way have tacitly assimi-

lated them, the assimilation may eventually be denied. . . . There is reason to suspect that, while private possession of things produced by labor will grow even more definite and sacred than at present, the inhabited area, which can not be produced by labor, will eventually be distinguished as something which may not be privately possessed. . . . Possibly the communal proprietorship of land, partially or wholly merged in the ownership of dominant men during evolution of the militant type, will be resumed as the industrial type becomes fully evolved.

After quoting these and similar passages from his revised opinions, Mr. Spencer makes the following observations: "The use of the words 'possible,' 'possibly,' and 'perhaps,' in the above extracts shows that I have no positive opinion as to what may hereafter take place." But of this Mr. Spencer feels sure: Nationalize the land on righteous principles of compensation, and the interest on the purchase-money would exceed the sum now paid in rent. Moreover, it is a "wild belief" that the land would be better managed—i. e., more profitably managed—by public officials than by private owners. "With a humanity anything like that we now know, the implied reorganization would be disastrous."

Well, we have only to do with the humanity that we now know; and being what it is, surely Mr. Spencer should have taken pains from the beginning to consider its manifold weaknesses and temptations. Yet still he repeats that the individual ownership of land was established by force, the assertion that Mr. Laidler and the Labor party of Newcastle stand upon. While, as for his perhapses and possiblies, they are in fact expressions of doubt as to whether the community will or will not resume ownership of the land, but they are not necessarily to be taken in that sense, and any Mr. Laidler might be forgiven if he saw in them a suggestion of the right thing to do, or a prophecy the fulfillment of which it would not be wrong to precipitate. All the more reasonably might he think so when he sees that in these same revised conclusions Mr. Spencer likens the acquisition of property in land by individuals to the old-time "ownership of man by man." "The ownership of land was established by force"; it originated in robbery; at the root it is robbery still. That is the point for Mr. Laidler; and, writing for humanity as we know it, and as the next generation is likely to know it, it is a pity that Mr. Spencer did not guard at once and in the strongest way against the probable use that humanity, as we know it, would make of the assertion. The possible resumption of the land by some totally different generation of humanity, one that we know not of, should not have been committed to print as the righting of a wrong, without the clearest warning that, till that generation comes, land nationalization must be an exceeding great folly, amounting to absolute disaster. For the good of humanity, that

was always the most important point to insist upon. It is to be feared that some thousands of Laidlers will not think so much of it now. So much does it become political philosophers to be careful. Some medicines are also poisons; such medicines should never be issued over the counter to any and every purchaser without a warning label; and this I hope I may say without seeming disrespect for Mr. Herbert Spencer.

Your obedient servant,

FREDERICK GREENWOOD.

November 7th.

PROF. HUXLEY'S LETTER.

To the Editor of "The Times":

SIR: I have read with very great interest the "heckling" of Mr. Morley, the letters of Mr. Spencer and of Mr. Greenwood, and your editorial comments on this triangular duel. But, if I may speak in the name of that not inconsiderable number of persons to whom absolute ethics and *a priori* politics are alike stumbling-blocks, permit me, borrowing a phrase which a learned judge has immortalized, to say that "You have not helped us much."

Let me explain the nature of the further help we require by putting a case which is not altogether imaginary:

A score of years ago A. B. bought a piece of land; he paid the price asked by the vender, and all the conditions required by the law were fulfilled in the transference of ownership. The transaction was as much a free contract as if A. B. had gone to market and bought a cabbage. At the time that A. B. handed over his money he believed that the State was a copartner in the contract, in so far that it undertook to maintain his rights of ownership against everything and everybody who should attempt to invade them, except an act of the Legislature, or the orders of the commanding officer in war-time, or a police officer legally authorized. A. B. has gone on paying his taxes to the State all these years, in full conviction that the State contracted, among other things, to afford him the protection thus defined.

A. B.'s lawyers assured him that the title to the land was perfectly good. This means that, for several centuries at least, neither force nor fraud has intervened, but that the land has passed from owner to owner by free contract. At the same time, A. B., who is somewhat pedantic in the matter of historical accuracy, admits that, for anything he knows to the contrary, in the reign of King John his bit of land may have belonged to Cedric the Saxon; and that possibly the son-in-law of that worthy thane, after the quarrel with Rowena, related by an historian of later date than Scott, may have taken forcible possession of it, and, in virtue of his favor at Court, kept it for himself and his descendants.

Now, my friends and myself, having no better guides than common morality and common sense, are of opinion that, supposing Ivanhoe to have behaved in this scandalous fashion, the fact makes not the smallest difference in justice or in equity to the title of A. B.; and that, if it did, the State, which has contracted to defend A. B.'s title without the least reference to such antiquarian contingencies, would commit a gross fraud if it broke its contract on any such flimsy pretenses.

The right to compensation is not in question; what we deny is the right to disturb A. B. on such a ground.

It would appear, however, that there is some better guidance than that of common morality and common sense; "absolute political ethics" is an infallible indicator of what we ought to do—whether the action indicated is possible or impossible.

Now, what we want is this very light as to what we ought to do in such a concrete case as that I have mentioned. The dictum that "ownership established by force does not stand on the same footing as ownership established by contract," I must repeat, "does not help us." Construed strictly, it is a mere truism; construed broadly, it may cover Mr. Laidler's view.

What we want to know is this: According to "absolute political ethics," has A. B. a moral as well as a legal right to his land or not?

If he has not, how does "absolute political ethics" deduce his title to compensation? And, if he has, how does "absolute political ethics" deduce the State's right to disturb him?

No question is raised here as to the right of the State to deal with A. B.'s land or anything else he possesses on grounds of public utility or necessity; nor do we want to know what may be done by the wisdom or the folly of future generations. "Absolute political ethics" should be independent of time and space; and it ought to be able to tell us whether, *in foro conscientiæ*, A. B., if he continue to hold his land under the circumstances supposed, is an honest man or a receiver of stolen goods.

I intervene in this discussion most unwillingly, but I have long been of opinion that the great political evil of our time is the attempt to sanction popular acts of injustice by antiquarian and speculative arguments.

My friend Mr. Spencer is, I am sure, the last person willingly to abet this tendency. But I am afraid that, in spite of all Mr. Spencer's disclaimers, the next time Mr. Morley visits his constituents his pertinacious "heckler" will insist that, after all, the younger and the older philosopher are not disagreed in principle; and that the difference of "footing" between ownership primarily based on force and other ownership can not be cured by efflux of time, and justifies the State now, or at any future period, in dealing differently with the two.

In Ireland confiscation is justified by the appeal to wrongs inflicted a century ago; in England the theorems of "absolute political ethics" are in danger of being employed to make this generation of land-owners responsible for the misdeeds of William the Conqueror and his followers.

I am, sir, your obedient servant,

T. H. HUXLEY.

November 11th.

SIR L. MALLET'S LETTER.

To the Editor of "The Times":

SIR: Mr. Frederick Greenwood's letter, and the leading article in "The Times" of to-day, on Mr. Herbert Spencer's recent letter upon this subject, leave little more to be said on several aspects of the question, but there are one or two points upon which I should be glad of an opportunity of adding a few remarks.

The passage in the "Political Institutions" quoted by Mr. Herbert Spencer has been long familiar to the students of his writings, and to some of them, who, like myself, are among his sincere admirers, has always been a subject of surprise and regret.

The whole extract should be read, but to save your space I confine myself to the concluding sentences, which are enough for my purpose:

> There is reason to suspect that while private possession of things produced by labor will grow even more definite and sacred than at present, the inhabited area, which can not be produced by labor, will eventually be distinguished as something which may not be privately possessed. As the individual, primitively owner of himself, partially or wholly loses ownership of himself during the militant *régime*, but gradually resumes it as the industrial *régime* develops; so, possibly, the communal proprietorship of land, partially or wholly merged in the ownership of dominant men during evolution of the militant type, will be resumed as the industrial type becomes fully evolved.

'The analogy here suggested between the ownership of man by other men, or slavery, and the private ownership of land, with the inference drawn from it, that as the first has been abolished in civilized countries the second may possibly share its fate, has always appeared to me essentially fallacious.

The principle of private property, so far as the term is applicable to human beings, has not in their case been abolished—on the contrary, it has been signally vindicated.

The destruction of slavery asserted the right of every man to property in himself, while prohibiting the ownership of man by other men, both individually and collectively. It was the restitution of a right of property from a wrongful to a rightful owner. In order to render Mr. Spencer's analogy applicable, it seems to me that the right of ownership in one man by another, instead of being abolished altogether, should have been transferred, as it is

proposed to do in the case of land, from the individual to the State.

But, however this may be, it seems clear that the principle which excludes the ownership of one man by another, rests upon the same grounds as that which includes private property in land —viz., that the general interests of society are best promoted by personal freedom.

There seems to be sufficient evidence that compulsory labor is less productive than free labor; and if this is so we may conclude, even setting aside all considerations of humanity or morality, that the interests of society are better promoted by free labor or property in one's self, than by slavery or property in others.

This is usually admitted, but it is necessary to insist upon what is always forgotten by those who declaim against private property in land—that this last institution also is an essential condition of personal freedom, as by no other means short of coercion can a due relation be maintained between demand and supply.

Whoever holds the land holds that which, being limited in extent (the only assumption on which the question arises), imposes on its possessor the function and duty, which he is bound in the interest of society, no less than his own, to perform, of restricting an undue pressure on the soil, whether for agricultural or urban purposes, whether for food or shelter, by the increasing wants of the population.

If the family is the economic unit, this object may be effected by the exercise of the personal responsibility and authority of its head in regulating supply, and by a gradual augmentation of price and rent in restraining demand. When the limits of production or supply are reached, any additional population must migrate or be supported, if possible, by charity.

But whenever the economic unit is extended so as to include a whole community, this personal responsibility, and with it personal liberty, disappears. In a small district (a village or canton) where the conditions approximate to family or patriarchal life the evil is mitigated; but in a large and complex society, to vest the property of the soil in the State—i. e., in a central Government, removed, as it must be, from all personal contact with individuals—is to throw upon it the paramount obligation of either regulating the increase of population or of providing food and shelter for increasing numbers by progressive inroads upon the accumulated capital of the country—in short, upon the net product, which is the only source of a progressive civilization. The first of these alternatives can not be better described than in the words of Bastiat:

Ce serait créer le plus faillible, le plus universel, le plus immédiat, le plus inquisitorial, le plus insupportable, et disons, fort heureusement, le plus impossible, de tous les despotismes que jamais cervelle de pacha ou de mufti ait pu concevoir.

The second course could only lead to the gradual pauperization and ultimate bankruptcy of any country which had the folly to embark in it. Such an experiment would be only comparable to that of a vast joint-stock company in which all comers were entitled to shares without paying for them.

The distinction drawn by Mr. Herbert Spencer, in common with the late Mr. Mill, between private property in land and private property in things produced by labor is one which I believe to have no economic justification whatever. It ignores the fundamental principle, on which the institution of private property is grounded—viz., that a due relation between demand and supply can be maintained in no other way consistently with personal freedom.

From this point of view the fact that the supply of land is practically limited, and that it is, therefore, a natural monopoly, renders it not less but more necessary that it should be allowed to be the subject of private appropriation.

Sir Henry Maine has summed up the whole question in a few words, which can not be too often repeated:

There are two sets of motives, and two only, by which the great bulk of the materials of human subsistence and comfort have hitherto been produced and reproduced. One has led to the cultivation of the Northern States of the American Union from the Atlantic to the Pacific; the other had a considerable share in bringing about the agricultural and industrial progress of the Southern States, and in old days it produced the wonderful prosperity of Peru under the Incas. One system is economical competition, the other consists in the daily task, perhaps fairly and kindly allotted, but enforced by the prison or the scourge. So far as we have any experience to teach us, we are driven to the conclusion that every society of men must adopt one system or the other, or it will pass through penury to starvation. ("Popular Government.")

I have the honor to be, sir, your obedient servant,

LOUIS MALLET.

13 ROYAL-CRESCENT, BATH, *November 9th.*

MR. SPENCER'S SECOND LETTER.

To the Editor of "The Times":

SIR: As Prof. Huxley admits that his friend A. B.'s title to his plot of land is qualified by the right of the State to dispossess him if it sees well—as, by implication, he admits that all land-owners hold their land subject to the supreme ownership of the State, that is, the community—as he contends that any force or fraud by which land was taken in early days does not affect the titles of

existing owners, and *a fortiori* does not affect the superior title of the community—and as, consequently, he admits that the community, as supreme owner with a still valid title, may resume possession if it thinks well, he seems to me to leave the question standing very much where it stood; and since he, as I suppose, agrees with me that any such resumption, should a misjudgment lead to it, ought to be accompanied by due compensation for all artificial value given to land, I do not see in what respect we disagree on the land question. I pass, therefore, to his comments on absolute political ethics.

> "Your treatment is quite at variance with physiological principles" would probably be the criticism passed by a modern practitioner on the doings of a Sangrado, if we suppose one to have survived. "Oh, bother your physiological principles" might be the reply. "I have got to cure this disease, and my experience tells me that bleeding and frequent draughts of hot water are needed." "Well," would be the rejoinder, "if you do not kill your patient, you will at any rate greatly retard his recovery, as you would probably be aware had you read Prof. Huxley's 'Lessons on Elementary Physiology,' and the more elaborate books on the subject which medical students have to master."

This imaginary conversation will sufficiently suggest that, before there can be rational treatment of a disordered state of the bodily functions, there must be a conception of what constitutes their ordered state: knowing what is abnormal implies knowing what is normal. That Prof. Huxley recognizes this truth is, I suppose, proved by the inclusion of physiology in that course of medical education which he advocates. If he says that abandonment of the Sangrado treatment was due, not to the teachings of physiology, but to knowledge empirically gained, then I reply that if he expands this statement so as to cover all improvements in medical treatment he suicidally rejects the teaching of physiological principles as useless.

Without insisting upon that analogy between a society and an organism which results from the interdependence of parts performing different functions—though I believe he recognizes this—I think he will admit that conception of a social state as disordered implies conception of an ordered social state. We may fairly assume that, in these modern days at least, all legislation aims at a better; and the conception of a better is not possible without conception of a best. If there is rejoicing because certain diseases have been diminished by precautions enforced, the implied ideal is a state in which these diseases have been extinguished. If particular measures are applauded because they have decreased criminality, the implication is that the absence of all crime is a *desideratum*. Hence, however much a politician may pooh-pooh social ideals, he can not take steps toward bettering the social state without tacitly entertaining them. And though he

may regard absolute political ethics as an airy vision, he makes bit by bit reference to it in everything he does. I simply differ from him in contending for a consistent and avowed reference, instead of an inconsistent and unacknowledged reference.

Even without any such strain on the imagination as may be required to conceive a community consisting entirely of honest and honorable men—even without asking whether there is not a set of definite limits to individual actions which such men would severally insist upon and respect—even without asserting that these limits must, in the nature of things, result when men have severally to carry on their lives in proximity with one another, I should have thought it sufficiently clear that our system of justice, by interdicting murder, assault, theft, libel, etc., recognizes the existence of such limits and the necessity for maintaining them; and I should have thought it manifest enough that there must exist an elaborate system of limits or restraints on conduct, by conformity to which citizens may co-operate without dissension. Such a system, deduced as it may be from the primary conditions to be fulfilled, is what I mean by absolute political ethics. The complaint of Prof. Huxley that absolute political ethics does not show us what to do in each concrete case seems to be much like the complaint of a medical practitioner who should speak slightingly of physiological generalizations because they did not tell him the right dressing for a wound or how best to deal with varicose veins. I can not here explain further, but any one who does not understand me may find the matter discussed at length in a chapter on "Absolute and Relative Ethics" contained in the "Data of Ethics."

It appears to me somewhat anomalous that Prof. Huxley, who is not simply a biologist but is familiar with science at large, and who must recognize the reign of law on every hand, should tacitly assume that there exists one group of lawless phenomena—social phenomena. For if they are not lawless—if there are any natural laws traceable throughout them, then our aim should be to ascertain these and conform to them, well knowing that non-conformity will inevitably bring penalties. Not taking this view, however, it would seem as though Prof. Huxley agrees with the mass of "practical" politicians, who think that every legislative measure is to be decided by estimation of probabilities unguided by *a priori* conclusions. Well, had they habitually succeeded, one might not wonder that they should habitually ridicule abstract principles; but the astounding accumulation of failures might have been expected to cause less confidence in empirical methods. Of the 18,110 public acts passed between 20 Henry III and the end of 1872, Mr. Janson, Vice-President of the Law Society, estimates that four fifths have been wholly or partially repealed, and that

in the years 1870–'72 there were repealed 3,532 acts, of which 2,759 were totally repealed. Further, I myself found, on examining the books for 1881–'83, that in those years there had been repealed 650 acts belonging to the present reign, besides many of preceding reigns. Remembering that acts which are repealed have been doing mischief, which means loss, trouble, pain to great numbers—remembering, thus, the enormous amount of suffering which this helter-skelter legislation has inflicted for generations and for centuries, I think it would be not amiss to ask whether better guidance may not be had, even though it should come from absolute political ethics.

I regret that neither space nor health will permit me to discuss any of the questions raised by Sir Louis Mallet. And here, indeed, I find myself compelled to desist altogether. In so far as I am concerned, the controversy must end with this letter.

I am, etc., HERBERT SPENCER.

ATHENÆUM CLUB, *November 15th.*

MR. LAIDLER'S LETTER.

To the Editor of "The Times":

SIR: As one of the deputation of members of the Newcastle Labor Electoral Organization who recently waited upon Mr. John Morley, M. P., to ascertain his opinions on certain political and social topics, I was intrusted by my fellow-members of the deputation with the question of the nationalization of the land, and this subject I discussed with Mr. Morley. In doing so, I sought to back up my position by quoting the ninth chapter of "Social Statics," by Mr. Herbert Spencer, and I certainly thought I had a good case when I found on my side the most distinguished authority of our time. To my great surprise I now find that in the letters which he has addressed to you, Mr. Herbert Spencer appears to be very anxious to repudiate the doctrines which he preached so eloquently in 1850. Now, although it is a common thing for the politician of to-day to repudiate principles and deductions which he formerly warmly espoused and to adopt others which he once energetically condemned, one does not expect the same vacillation on the part of a distinguished philosopher like Mr. Herbert Spencer. I find it difficult to understand his position, which seems to be this—that while adhering to his general principles he abandons certain deductions therefrom. Now, to my mind, the ninth chapter of "Social Statics," which deals with "The right to the use of the earth," seems as true, as logical, and as unanswerable an argument in favor of the nationalization of the land as it doubtless appeared to Mr. Herbert Spencer on the day it was written. Let us trace the course

of his argument through the ten sections of which the chapter is composed:

1. Given a race of beings having little claims to pursue the objects of their desires, and a world into which such beings are similarly born, it unavoidably follows that they have equal rights to the use of this world. Conversely, it is manifest that no one, or part of them, may use the earth in such a way as to prevent the rest from similarly using it.

2. Equity, therefore, does not permit property in land. Otherwise, landless men might equitably be expelled from the earth altogether.

3. We find yet further reason to deny the rectitude of property in land. Violence, fraud, the prerogative of force, the claims of superior cunning, these are the sources to which titles may be traced. Could valid claims thus be constituted? Hardly. If not, what becomes of the pretensions of all subsequent holders of estates so obtained?

4. Not only have present land tenures an indefensible origin, but it is impossible to discover any mode in which land can become private property. Cultivation can not give a legitimate title.

5. Why not agree to a fair subdivision of the land? Until we can demonstrate that men born after a certain date should be doomed to slavery, we must consider no such allotment permissible.

6. Either men have a right to make the soil private property or they have not. No compromise is possible. If they have such a right, then the Duke of Sutherland may justifiably banish Highlanders to make room for sheep-walks.

7. After all, nobody does implicitly believe in landlordism. If a canal, a railway, or a turnpike road is to be made, we do not scruple to seize just as many acres as may be requisite. If we decide that the claims of individual ownership must give way, then we imply that the right of the nation at large to the soil is supreme.

8. To what does this doctrine, that men are equally entitled to the use of the earth, lead? Instead of being in the possession of individuals, the country would be held by the great corporate body—society. Instead of leasing his acres from an isolated proprietor, the farmer would lease them from the nation. Clearly, on such a system, the earth might be inclosed, occupied, and cultivated in entire subordination to the law of equal freedom.

9. No doubt great difficulties must attend the resumption, by mankind at large, of their rights to the soil. The question of compensation to existing proprietors is a complicated one—one that perhaps can not be settled in a strictly equitable manner. But there are others besides the landed class to be considered. The rights of the many are in abeyance. To deprive others of

their rights to the use of the earth is to commit a crime inferior only in wickedness to the crime of taking away their lives or personal liberties.

10. The right of each man to the use of the earth, limited only by the like rights of his fellow-men, is immediately deducible from the law of equal freedom. The maintenance of this right necessarily forbids private property in land. The theory of the co-heirship of all men to the soil is consistent with the highest civilization, and, however difficult it may be to embody that theory in fact, equity sternly commands it to be done.

In the foregoing digest, beyond one or two connecting words, the language is that of Mr. Herbert Spencer himself. Does it not constitute an unanswerable argument in favor of the nationalization of the land? If the author would permit it to be reprinted, what an admirable tract the ninth chapter of "Social Statics" would be for the propagation of Socialistic principles! But he now seems to repudiate the offspring of his own genius! We have, however, a right to ask that, instead of a vague repudiation in general terms, Mr. Herbert Spencer should tell us specifically what deductions he has abandoned and why he has abandoned them. We might then endeavor to answer his answers to his own propositions.

Yours,

JOHN LAIDLER, *Bricklayer.*

TWO AND A HALF PER CENT.

By GEORGE ILES.

THE fall in the rate of interest is one of the most striking facts in the financial history of this generation. At times the price of money has risen, and investors have hoped that the good old rates were to be a permanency; but interest has soon declined again, vibrating about a point a little lower than the center of its former seesaw.

Last April, the city of New York, in purchasing certain uptown parks, sold stock bearing 2½ per cent per annum, maturing in twenty years, and exempt from city and county taxation. The stock, $7,457,000 in amount, brought on an average 100$\frac{1}{16}$. High as the credit of the metropolis stands with investors, still higher stands the credit of the United States. Its bonds last April netted a return at current market prices of but 2·07 per cent. During the decade ending with January, 1889, the average rate realized on a United States Government bond was 2·72 per cent; during the preceding ten years it was 4·06 per cent, very nearly one half more. Comparing the nine years and nine months ending Octo-

ber 31, 1889, with the decade preceding, the rate of discount charged on prime commercial paper by the banks of New York city declined from an average of 6·23 to an average of 5·29 per cent. The Bank of England's rate concurrently compared shows the relatively small diminution of from 3·40 to 3·28 per cent.*

As far as concerns the manufacturing and trading public who obtain credit at banks in the United States, the decline in the rate of interest has been slight. It has been very different with regard to returns obtainable from investments of the highest class, such as those offered on the bonds of the United States Government, and of the great cities with credit unsmirched by traditions of bankruptcy or repudiation. An investor in a Government bond has certainly a form of property wherein the cares of ownership are brought to the vanishing-point. His security is absolute; his bonds are registered, so that he need fear no thief; he can sell all or any part of them at pleasure; and, should he desire to pledge them for a loan, no operation is simpler and easier. Still, two things remain to be desired—the perpetuity of the obligation, and a larger supply of the securities. In a term of years, all too brief, the bonds will be paid, and the question of reinvestment will come up, perhaps to be settled by heirs and assigns who may be tempted by a shrinking rate of return to accept securities which are no securities. Railroad financiers have noted the demand for permanency in investments, and have profited in supplying it. For example, certain permanent debenture stock issued by the Canadian

	Rate realized on U. S. Government bonds at average January prices.	Rate of discount charged by banks in New York city for prime commercial paper; average for year.	Bank of England's rate of discount; average for year.
	Per cent.	Per cent.	Per cent.
1870	4·86	8·08	3·44
1871	5·28	6·13	2·88
1872	5·06	6·38	4·09
1873	4·50	9·92	4·89
1874	4·58	5 98	3·69
1875	3·94	5·51	3·23
1876	2·28	5·12	2·61
1877	2·40	5·21	2·91
1878	3·69	4·81	3·78
1879	4·00	5·19	2·50
1880	3·75	5·33	2·76
1881	3·25	5·19	3·48
1882	3·00	5·67	4·15
1883	2·87	5·56	3·57
1884	2·60	5·40	2·96
1885	2·63	4·18	2·92
1886	2·50	4·95	3·05
1887	2·23	5·79	3·34
1888	2·28	4·87	3·30
1889	2·07	...	...
1889, January 1 to October 31	...	5·91	3·25

Pacific Railway Company, is quoted at 123; certain other of its bonds, equally well secured, but payable in 1937, are quoted at 110; both bear five per cent. Investors of the wealthiest class prefer investments which, while absolutely secure, may be subscribed for in blocks of a quarter to a round million—a desideratum which further restricts their choice. An electric current may be so intense as to become an obstacle in its own path; a vast volume of capital in the hands of an individual has somewhat the same effect.

While the rate of interest on Government bonds, and city and railroad debentures has been steadily falling within the past two decades, the rates payable on real-estate mortgages have declined in sympathy. This year, in New York and Boston, liens on the best city property have been placed at four per cent, two per cent less than the rates current in 1869. In other large cities of the Union a similar decline is observable; and, as between newly settled States and Territories and the financial centers of the nation, the disparity in the rates payable on well-secured loans is much less to-day than it was twenty years ago. The significant point in the matter under consideration is not so much that the rate of interest has been falling as that interest has become distinctly separated from the wages of superintendence and the premium for incurred risk, which used to be combined with it. The return on a Government bond represents the bare remuneration of capital employed, without hazard or care. An investor in first-class city mortgages receives a larger income than if he had bought Government bonds with his money, but he has not so easy a time of it. He must have titles carefully and responsibly examined; his creditors may be unpunctual; occasionally he may have the trouble of a foreclosure on his hands. His investments are for comparatively short terms of years, and, between one investment and another, part of his capital may be unproductive; or, in reinvesting, he may be obliged to accept a reduced rate. Hence the competition for securities eliminating hazard and bother, which is one of the notable facts in the modern world of finance. Many causes have been at work in bringing down the return on a New York debenture to five eighths as much as can be obtained on a Fifth Avenue or Broadway mortgage. First of all, of course, must count the enormous growth of American wealth within recent years; and, next, the fact that a good deal of it is in the hands of comparatively few men. A multi-millionaire's income, even at the lowest current percentage, is so much more than his outgo that, if he can be relieved from care and anxiety in looking after his possessions, he is often content to buy securities paying but half as well as the best properties did twenty years since. Another prime cause for the fact under notice is the steady approximation to European rates of interest which has been going on since the close of the

war. With trade restored to its normal channels, and a steady reduction in the national debt, have come a constant appreciation in national securities. Ever-improving means of intercourse by steam and telegraph have brought about a better knowledge in Europe of other leading American investments, and a competition for them which makes the London demand in substantial sympathy with that of New York. Meanwhile, too, European rates of interest have fallen; in 1887 Germany was able to convert her 3½'s into 3's; last year Great Britain refunded a large portion of her debt, which had borne 3 per cent, at 2¾, with a liability for but 2½ after a certain term. Among the consequences which have followed the diminution of income from secure European investments has been the invasion of the American industrial field by European capital. This invasion, partly prompted by the fear of continental war, in seeking to add profit to interest, must both tend to increase commercial competition in America and contribute to further lower the rate of interest. A fact recently presented by Mr. M. A. Neymarck, the French economist, is worth mentioning in this connection: when the existing redeemable debts of France, of Paris, and of the French railway companies are paid, the redemption prices will exceed the issue prices by $1,300,000,000.

While the progress of science, applied to developing the resources of this country, has prodigiously increased its capital, the ratio of it offered for safe investment has increased at the same time. Savings-banks, trust companies, building associations, insurance companies diverse in type, afford, as it were, a thorough system of conduits to bring every tiny rill of saved earnings to some great reservoir of accumulation. Despite America's increase of population, there are now, probably, fewer hoards of money in its old stockings than ever. When tenders for city, county, State, or railroad bonds are opened, it is usual to find that the majority of competitors are trust companies, savings-banks, and other concerns representing small investors, whose demand first and chiefly is that their security shall be unquestionable. To this numerous class a vitally important inquiry is, Are we to expect a rise or a fall in the rate of interest? In considering this question it will be enough, in passing, to say that abnormal influences affecting the rate of interest are the remote contingencies of foreign war or civil commotion; the normal influences are chiefly four:

First, the comparative efficiency or reproductive power of capital; next, its security, depending on the character and ability of those who handle it; third, its supply and demand; lastly, the soundness of the currency, assuring the repayment of loans in undepreciated money. With respect to the first factor, a glance is enough to show it to be two-sided. In the new South and new

West, virgin forests, prairies, and mines offer as splendid opportunities to enterprise as enterprise has ever known; so far, therefore, the demand for capital to develop these new resources will tend to raise, or at least to conserve, the rate of interest. While this is true, it must be remembered that a given amount of capital is more efficient now than it ever was, that its efficiency increases; which means lessened demand for it, tending to reduce the terms paid for its use—unless new and profitable applications of capital can be made. As invention after invention is perfected and introduced, the outlay for machinery required to make a million pairs of shoes steadily diminishes. Quick and cheap railroad transportation enables a country merchant to keep his stock at a minimum by constantly "sorting-up"—reducing the capital needed for his business. Telegraphic purchases and payments now exclude the necessity for locking up capital while correspondence goes on through the post-office. In the vast stores of capital, set free in these and similar ways, arrives the opportunity for inventiveness, taste, and skill to create new wants, to supply them and some old wants as well which have long gone hungry—to increase the quantity and improve the quality of life. In so far as such new applications of capital are not commercially reproductive, they tend to maintain the rate of interest.

Next, as to security in investment. During recent years there has been an immense growth of American capital in the hands of people unable or unwilling to superintend its application in business, people in the main desirous of thorough security in their investments—many of them executors and trustees. Financiers have not failed to observe this state of things; it has enabled them to obtain vast loans at comparatively low and diminishing rates. Of late years have appeared innumerable issues of bonds, debentures, and mortgages; covering not only railroad property, but mills, elevators, apartment-houses, office and club buildings. When the loans obtained by these wholesale borrowings have been remuneratively applied, the result has been all that the lenders could wish. But, unfortunately, the securities which warrant a buyer in dismissing caution and the necessity for discrimination are few indeed. The popularity of coupon bonds has extended from those of a substantial description to many of little or no value. During the year ending June 30, 1888, twenty-one per cent of the bonds outstanding on American railroads paid no interest; the capital involved being no less a sum than eight hundred and twenty-seven million dollars. Of allied significance is the fact that in 1888 one in every ninety-eight firms in business in the United States became insolvent. Despite improved methods of transacting business, of estimating credits through mercantile agencies, there persists an overtrading which burdens the com-

munity with a heavy tax for bankruptcy. That administrative ability is much rarer than opportunities for its exercise is clearly one of the causes for low interest, and for the addition thereto which bankers and other lenders must charge in order to cover commercial risks.

The third influence bearing on the rate of interest is the comparative scarcity or plentifulness of capital. This is determined not only by the amount and efficiency of capital productively employed, but by the ratio of reproduced capital which is saved. Taking it by and large there seems no reason to believe that habits of thrift are losing their hold on the people of this country. As will shortly be seen, the returns of savings-banks bear this out. If persons of small capital are exposed to a reduction of interest from the safest forms of investment, this very liability may lead to greater thrift among those of forecasting mind. Where accumulation is quite too small for its income to yield a living, it is the capital sum that is looked to as a resource against a rainy day.

Lastly, as to the soundness of the currency. While "the consensus of the competent" holds that there is the menace of financial derangement in the legal-tender decision of the Supreme Court of the United States, and in the silver legislation of Congress, neither of these seems as yet to have affected the rate of interest. To provide against the contingency of a depreciated currency, whether fiat-paper or silver, now sought to be artificially bolstered in value, certain loans of large amount have recently been effected in Wall Street with the express stipulation of payment in gold coin. The precaution is significant.

Refraining from any attempt to weigh and balance others of the multifarious influences working for the depression or elevation of the rate of interest, it may be enough to say that the prevailing impression among both economists and men of business is that downward influences will probably continue the stronger in the years of the near future. This means hardship to many worthy people whose time of competence it postpones indefinitely; hardship, too, for the class who, unable to accept business risks or manage business investments, must needs accept less and less return from a little capital. Small comfort for them to hear that prices are falling, so that their loss of income is largely or wholly offset; does not rent rise constantly, and does not the area of "necessities" expand the while with an imperiousness scarcely to be withstood? But, turning from cases of this kind, which are after all comparatively few, the reduction of the rate of interest paid by secure investments is in the main a benefit; it means increase in the shares of produced wealth divisible as wages and profits, if it also means more for rent. It indicates that the

growth of large fortunes is likely to be slower in the future than it has been in the past; and the growth of large fortunes is in many quarters regarded as a menace to industrial and political freedom. That wages have in the main risen during the past twenty years is clearly shown in the statistics of the State and National Labor Bureaus. In many trades money-wages have advanced; in others, where they have remained stationary or fallen a little, their purchasing power has increased; in a few trades, superseded by newly devised machinery, and in the case of unskilled labor subjected to competition with hordes of immigrants accustomed to a low standard of living, wages have fallen below the purchasing power of those paid twenty years ago. No State in the Union adds to her population more immigrants of the wage-depressing type than New York; still, on July 1, 1889, her savings-banks held on deposit $536,417,974, due 1,389,907 depositors. The amount had increased $22,000,000 during the preceding twelve months, and $201,000,000 during the preceding nine years. These figures prove a rapid improvement in the condition of the working people of New York; and, since migration from New York to other States is easy and cheap, her advance in general prosperity may be fairly interpreted as gauging prosperity throughout the nation.

While, then, wages have been rising and interest falling, a new method has perforce entered into the management of large properties. It used to be remarked, as a characteristic of American engineering, that it presented not the best thing, but the lowest-priced thing that would serve. This is true no longer. Everywhere we find railroads adopting the most substantial types of construction and equipment. Steel rails long since replaced iron rails; now steel bridges are replacing wooden bridges; not only on trunk lines, but on local roads, large outlays are being constantly made for improved curves, gradients and ballasting. Already the increase in the cost of lumber, due to forest destruction, has brought in the experimental use of steel both for ties and for car-construction. A steel tie is dearer than a wooden one, but its life is vastly longer. The same principle obtains in mills and factories: net profit can be increased by a judicious increase of capital expenditure, which adds to the account for interest, but deducts a larger sum from disbursements for maintenance, repairs, and accidents. Cheap money for good security has, too, had much to do with the new architecture of our cities—architecture which employs granite instead of sandstone, substitutes sandstone and marble for brick, and demands brick of new durability and beauty. In quite modest dwellings it is now usual to find hot-water or hot-air furnaces instead of the heating stoves still general a decade ago; ranges and gas-stoves for cook-stoves; elaborate laundry

appliances; electric bells—all intended to minimize service at the expense of an increased original outlay. If the occupant of a suite in a New York apartment-house, who has abandoned a self-contained house, is asked the reason, he will probably say, "I pay just as much rent, but I get along now with fewer servants."

The tendency observable on all hands to provide durability in the stead of flimsiness, the most elaborate and complete machinery for anything short of it, is accompanied by another tendency in no sense economical. When banks and office-buildings display floors of rich mosaic, walls and ceilings of variegated marble, staircases of Mexican onyx, it is evident that luxury brings a price as well as wholesomeness and commodiousness. Throughout the Union every considerable city has its structures of this type discovering the sky, mostly erected by insurance companies who seem to be hedging on the fall in the rate of interest by reaching out after unearned increment.

Rent has been affected in diverse ways by the cheapening of secure loans. In so far as mining privileges and the like can be worked with less cost for the hire of capital than ever, their net income, rent or royalty, has increased. Farming lands of all kinds but the best situated or the most fertile have tended to fall in rent as massed capital has become cheaper. Railroads, in opening up vast tracts of new territory with great rapidity, have kept the values of even the best farming land lower than they would otherwise have been. In the same direction also has operated the lowered rate at which money can now be borrowed on farm buildings and machinery. In the cities and larger towns rents have risen remarkably within twenty years, yet the rise would have been greater still had not the rate of interest dropped. Rent in cities and towns, as elsewhere, depends upon two values—that of land apart from improvements, and that of improvements. The first of these values is determined by the comparative salubrity, publicity, convenience, and beauty of sites; other things equal, it will tend to rise as the income of the average citizen rises—with the increase of ability to compete for advantages desired. The rental value of improvements, of all that capital adds in preparing for a building, constructing it, and fitting it up, will tend to approximate to the rate of interest payable on approved real-estate security. In New York city, where land is usually more valuable than the buildings which cover it, low terms for mortgage interest have not affected rents so much as in smaller cities where buildings are as valuable as or more valuable than their sites. Last spring a block of tenement-houses in New York sold at a price so high as to realize its purchaser but six per cent as a gross return on his investment. If his rents remain unchanged, any further fall in the rate of interest will enhance the price of his property. This

incidentally illustrates how as interest falls land values rise, and explains the growing appreciation of home-owning in cities and their suburbs.

According to the statistics of the Interstate Commerce Commission, the bonded, share, and floating liabilities of American railroads amounted to $8,129,000,000 on June 30, 1888.* It is not likely that science has any such revolutionary gift for mankind in the near future as the railroad; and as American capital at this time demands new outlets whereby to effect new economies or save noteworthy waste, it may be allowable to note some fields for sound investment as yet unoccupied. Is not the improvement of our towns and cities, as such, a field which capital might well enter? Recent investigations by Captain Francis V. Greene, of New York, and other experts, demonstrate that, were the city's pavements as good as they should be, horses could draw threefold greater loads over them, with an immense abatement of both noise and filth. While the improvement of the metropolis due to individual enterprise and taste has been marvelous of late years, its mansions and business structures vying with the finest in the world, the city as a city is little changed. Its gas, water, and sewer pipes are still laid in the earth beneath its streets, subject to unceasing disturbance for repairs. Its electric wires, for many years a grievous eyesore, a menace to pedestrians and an obstruction often fatal to its firemen, at last have so multiplied in number and deadliness that a beginning has been made in laying them underground—a tentative procedure attended with all the uncomfortable results of an underground piping for gas and water service. Repeatedly the suggestion has been made, echoed at last in the City Hall, that subways be constructed for the accessible disposition of gas, water, and sewer pipes, and for electric wires. Never until this suggestion is acted upon will the city's pavements be free from constant breaks, which, were repair of the carefullest, would never permit New York streets to remain smooth and seemly. Subways of the kind proposed could easily accommodate pneumatic tubes for the conveyance of postal letters and parcels. To-day the mails traverse New York, much as furniture and vegetables do, in common vans. So slow is their delivery that letters from Albany, arriving at the Grand Central Station at 7 A. M., reach Fourth Avenue and Thirty-second Street partly at 10.40 A. M., but in larger part between 12.40 and 1.10 P. M. The point named is half a mile from the station, on the way between it and the Post-Office. The quickest train from Albany to New York travels the distance, one hundred and forty-eight miles, in three hours and thirty minutes; a letter traversing a distance of six miles within the city occupies

* Of this stupendous total, 39 per cent had made no return whatever during the preceding twelve months.

on an average five hours. Long ago the Western Union Telegraph Company connected its Madison Square branch with its headquarters on Dey Street: written messages are transmitted through its cylinders, two and a half inches in diameter, at the rate of a mile a minute. The tube in its course connects with three branch offices in Broadway—a hint for the pneumatic connection of branch post-offices with the general Post-Office, which, extended to the principal railway stations and ferry-houses in the metropolitan district, would give the postal service a new efficiency. More important than this pneumatic tubing is the question of rapid passenger transit, the inadequacy of existing methods being peculiarly impressive as the great exhibition of 1892 is discussed. Whether by tunnel or viaduct, it seems imperative that New York, at an early day, shall provide itself with transit facilities such as those of the German capital, where trains stopping at all stations, and trains running at high speed stopping only at the principal stations, run on separate sets of tracks.

This continent is, after all, only a larger kind of island, and increase of transatlantic travel has been needed to remove some of its insular complacencies, especially that with which it has hitherto regarded the condition of its streets.

In common with New York, every city and large town in America requires what may be called integration—a thoroughly comprehensive and intelligently planned outlay of capital for every means of welding it into a unit—commodious, wholesome, and pleasant to live in; easy and cheap to get about in. There is an art of city design as well as house design: modern house planning not only bestows new comforts and refinements, it makes them all part and parcel of a whole. When cities and towns are treated structurally exactly as a good architect treats the edifice an unstinting capitalist asks him to create, life in them will be much better worth having than it is. And the financial opportunity to do all this appears when New York can borrow money at two and a half per cent—a rate one half as much as her citizens are obliged to pay for individual borrowings. What has been said with regard to cities and towns applies equally to means of communication between them and villages—the common roads, whose badness Prof. Shaler tells us imposes a tax of at least ten dollars a year on the average American household. Road improvement offers scope and verge for the profitable and safe investment of a good many millions now idle. Passing from matters of municipal and county administration to State and national interests, does not cheap and abundant capital make it possible to conserve the Adirondacks as a State park, and as the source of the principal rivers of New York; to establish a national system of afforestation; to reclaim the arid plains of the

far West to fertility; to take in hand on broad lines the improvement of the nation's water-ways? Governments, honest and able, can do many things for the common interest which the people as individuals are powerless to do for themselves. Honest and able, there's the rub! The municipal administration of Berlin, a city well-nigh perfect in government, is carried on for a trifle more than the interest on the public debt of New York. Abounding cause is there to fear waste, corruption, and incapacity in any extension of governmental functions which the future may develop. Still, it is not so much fear of this kind which prevents that extension, as a lack of perception by the American people, governing and governed, of the great benefits that can follow the organized action of municipalities, counties, States, and the nation itself. There is much deploring of political degradation and political immorality: may we not reckon in the future, among the forces working for reform, that of capital wrongly excluded from vast fields of usefulness and profit?

THE RARE FORMS OF ORCHIDS.

By J. DYBOWSKI.

THE varieties of plants which, under various titles, charm us as house-ornaments, and give our habitations a character of freshness and life that is always dear to us, are already numerous. Right along with their growing number goes our increasing affection for them. They are not of the kind of things we tire of as soon as we become acquainted with them; but the more intimately we know them the more disposed we are to seek for new ones. They will never become common. We might suppose that, the more numerous rare flowers become and the more fond amateurs grow of them, common flowers would fall into neglect. But this is not so. We are not only fond of flowers because they are rare or precious, but we love them also for themselves and for the attractions of their own that they possess. In the grand army of flowers which seem made to impress a tone of the gay on the sober background of our existence, there are some stately ones that appear to constitute a kind of aristocracy of this enchanting world.

Such flowers are the subject of our present essay. The orchids, conquerors of the light, may well claim pardon for their triumph over their humble companions of the gardens, for their victory is fairly achieved. They astonish us when we first examine them, then charm us. Nature has been liberal with them, and they have everything. Their flowers are full of that curious

charm that captivates. Their colors are harmoniously toned, and always bright and elegant. Their odor is sweet and penetrating, but does not cloy. Notwithstanding their thin texture, which gives them a delicate and frail air, they last longer than other ornamental flowers. Nothing, in fact, seems to be wanting to them but a more lively and abundant foliage; and that can be supplied by mingling fern-leaves with them.

It was long supposed that these wonderful plants were extremely delicate and capricious. This was a mistake. To their other virtues they join the rare one of simplicity.

Nearly all the orchids cultivated in greenhouses are natives of the intertropical zone, and it was supposed from this fact that they required considerable heat. But it has gradually been established that a high temperature really hinders their best development. A considerable number of them in their native state grow on high mountains, under exposure to a bracing atmosphere; and they are now cultivated in moderately warmed and freely ventilated greenhouses. They are therefore relatively hardy plants, well adapted to the decoration of our rooms.

The genera and species of orchids already known are very numerous, but the varieties are more so. The cause of the multiplicity of form, shade, and appearance lies chiefly in the organization of the flower. Without going into technical details and descriptions, it is enough to say that the pollen is not spontaneously carried to the stigma, and that a foreign agent has to intervene in the fertilization of the seed. The office is discharged by insects, which visit the flowers for their honey and involuntarily load themselves with pollen; then, flying from one flower to another of different varieties and species, they effect all kinds of mixtures. Consequently, varieties are endlessly multiplied. While many of these may be common, others obtain special hues or streaks, which render them rare and cause them to be sought out by collectors. Now that orchids are in full favor, and are likely to continue so for a long time, enormous prices are paid for the choice varieties.

A *Cattleya* (Fig. 1), shown at a recent horticultural exhibition in Paris, had a light violet-blue corolla instead of the usual rose-violet. This sport in color was enough to raise the price of the plant to ten thousand or twelve thousand francs. The owner —M. Piret, of Argenteuil—had himself sought out the variety in the forests of Venezuela. The instance is not a rare one. At a recent sale in Ghent, every specimen of a certain *Cypripedium* brought six thousand francs; and like prices are often obtained in England. The ordinary prices in trade are, however, more moderate than this. As the result of numerous explorations, often made at great risk of life, orchids of all kinds and of the more usual varieties have been imported by thousands within the last

few years, and are sold at reasonable prices; and the business of dealing in them returns little profit unless some of the rarer varieties are on the list.

While it is difficult and dangerous to go to their native haunts for orchids, it is not much more easy to possess the rarer varieties in cultivation; for, while the care of adult plants is compara-

FIG. 1.—ORCHIDS, *Cattleya nossia* (bluish mauve).

tively easy, the raising of the seedlings is attended for many years with almost insurmountable difficulties. But cultivators have become possessed with the idea that it would be well to imitate with species selected for their beauty and good forms the accidental hybridizations of the forests. Many have tried; a few have succeeded. One of the first among these was M. Bleu, General Secretary of the French Horticultural Society. He cross-fertilized, sowed the seeds, and raised young plants. To appreciate the difficulties of these operations, they must be followed out. In the first place, the seeds are so fine that they can not be seen without a strong glass; they are sown on the bark of trees or in chopped moss; and they are transplanted when the plants are so small that the work has to be done by the aid of a magnifier. These material difficulties are still as nothing compared with the care that has to be given the nurslings to secure a good development of them. The cultivator may consider himself fortunate if he gets a few dozen good plants out of several thousand seedlings.

Orchids in all their varieties of aspect and form have very dif-

ferent ways of growing. Some, like the lady's-slippers (*Cypripedium*) and the superb *Odontoglossums*, are ground-plants; others, perhaps most of the class, are epiphytes, attaching themselves to the bark of trees, where they live at considerable heights above the soil. Of this class are the fragrant *Cattleya* and the splendid *Phalænopsis*, so elegant with great bunches of white or rose-colored flowers.

It follows from this great diversity of exigencies that orchids lend themselves readily to all possible combinations in the ornamentation of rooms. Some are cultivated in pots and help in the decoration of *jardinères* (Fig. 2); others, which live on the trunks

FIG. 2.—ORCHID-GROWING IN A ROOM.

FIG. 3.—CORSAGE BOUQUET OF ORCHIDS.

of trees, can be placed in hanging baskets, or fixed in front of a mirror which will reflect their graceful figures.

Orchids will last a long time in a room if proper care has been taken in cutting and transporting them. The flower will sometimes keep its freshness for two or three weeks. Their preservation may be prolonged by covering them every evening with a sheet of silk paper, which will protect them from dust and excessive evaporation. They lend themselves remarkably well to the formation of bouquets, where their quality of keeping fresh for weeks gives them much value. An effective bouquet shown at a horticultural exhibition in Paris, which was formed by attaching orchids mingled with branches of asparagus to moss-covered bamboo sticks, is shown in Fig. 4. On account of their enduring freshness orchids are favorite flowers for bouquets to be worn on

festive occasions, and a considerable trade has been developed in flowers for such uses. Favorite kinds for this purpose are the *Odontoglossums*, with handsome white, starry flowers, and the *Oncidium papilio*, with its butterfly-shaped corolla.

FIG. 4.—MOTIVE IN CUT ORCHIDS, MOUNTED ON BAMBOO.

The enormous sums that are often paid for orchids are decried as foolish, and the extravagance is sometimes compared with the craze that once raged about tulips. The two fashions are not to be compared; for there is something real and solid about orchids, which will always give them rank among the finest and most highly esteemed flowers; while tulips are not fine, and soon suffered a loss of the extravagant admiration that prevailed for them for a time. New varieties of the rose, although it is a very old flower, still bring higher prices than the rarest of orchids.—*Translated for the Popular Science Monthly from La Nature.*

ONE point of great interest observed by Dr. Nansen in his expedition across Greenland was the very low temperature in the interior, which seems to be in departure from the received meteorological laws. This may, he thinks, throw a good deal of light on the much-discussed question of the cause of the great cold of the Glacial period. No better place can be found for the pursuit of this inquiry than Greenland.

IRRIGATION OF ARID LANDS.

By HENRY J. PHILPOTT.

THERE is no more striking difference between the inhabitants of the Eastern and Western United States than the degree of their familiarity with the word *irrigation*. And there will never be a profounder difference than will be engendered by the thing itself. The Eastern farmer irrigates his cabbage and tomato plants when he first transplants them. His wife irrigates her flowers. The city gentleman irrigates his lawn. But the idea of watering a whole farm—not a New England "patch," but a Western ranch of from fifty to fifty thousand acres—seems a financial absurdity. What the Eastern farmer could not produce without such expensive cultivation he would say was not worth producing.

Equally incredible will seem farming without irrigation to the generation now growing to manhood over a large part of the Pacific coast. To them it will seem an absurdity not to have the water as fully under your own control as the land. They would not want to cultivate land if they had to take chances on there being neither too much nor too little rain.

What would surprise the Eastern farmer still more, if he knew it, is that thousands of acres of land, intended for nothing but hay and pasture, are not only irrigated from ditches a dozen miles long, but must first be leveled down with road-scrapers, and often the grading costs twenty-five dollars an acre. This, however, applies only to certain forms of irrigation. My present purpose is to describe a number of different ways of irrigation which I have seen exemplified on a large scale.

The simplest plan is with a street-sprinkler. It is profitable on certain crops of high value per acre. For irrigating trees and vines the spray may be taken off the wagon and a straight stream conveyed by a short hose to the roots. I have seen vineyards of one hundred acres watered in this way. It is chiefly used in tiding young vineyards and orchards over the first year, on land which thereafter will need no irrigation. It always struck me rather comically to see a street-sprinkler meandering over a field thirty miles from the nearest town, as if it had got lost and were groping about and trying to find its way back to its native haunts.

In such case the original source of the water may be a well or a mountain cañon. I confess it still staggers me to see the miles of iron pipe through which a stream of irrigating water must often be carried from the mountain spring to the nearest field whereon it is to be used. A two-inch pipe, by the time it is laid,

costs anywhere in the neighborhood of one thousand dollars a mile.

Wherever the water comes from, it is usually conveyed into a tank or a reservoir, and then piped or ditched about over the farm wherever needed. A hand pump is a rarity in southern California. A windmill pumps the water into a high tank, which gives it the pressure needed for sprinkling. Hydrants are placed at the house, at the barn, in the garden, in the orchard, and at other points. With plenty of hose the fire protection is admirable. The farmer's wife is as well off as her city cousin in the matter of water conveniences.

Running through iron pipes near the surface of a blistering hot soil, the water gets warm, not to say hot, and so it does standing in the tank over the well. When wanted for drinking, it is put into a porous earthen jar called an *alla*, and the evaporation of the large part which soaks through the jar cools the contents. Always in the morning, and nearly always throughout the day, you can get a drink as cool as the stomach ought to have. Sometimes a barrel, covered with a cloth kept wet, is used for the same purpose.

The water thus piped to various points on the farm is sometimes carried from the hydrants through ditches which run along the highest parts of the ground. These ditches are the simplest possible in construction. They go winding about like natural streams. Sometimes a furrow of the large farm-plow answers every purpose. For the capillaries of the circulation the furrows made between the rows of vegetables in cultivating them are quite sufficient. When you have irrigated a few rows, a hoeful or two of earth applied to each furrow stops the water from them, and then the dam is removed farther down the main stream, and more rows are irrigated in the same way.

The method of irrigating trees is different. A circular depression, with a raised rim, is made about the tree. In a large orange orchard this is done with a machine—a kind of complicated scraper dragged around each tree by horses. The saucer thus formed may be fifteen or twenty feet, but is usually much less, in diameter. The water is turned into it from a hose or through a surface ditch. An orange grove never looks prettier than when thus prepared for irrigation. Sometimes, instead of the circular basin about each tree, small ridges are thrown up midway between the rows, in both directions. This makes a larger irrigated surface, and, of course, requires more water.

All these methods of irrigation are simply extensions of ordinary garden watering. I have seen two other quite different methods in operation. One of them is the simplest and cheapest, the other the most complicated and expensive of all.

In the former nothing is done except to dig a large ditch through the field, as near the middle as is consistent with its following sufficiently high ground, or between two fields, if both are to be watered from it. Through this ditch, or *zanje*, a slow stream of water is kept running. It soaks into the ground and percolates or "seeps" through it and thus sub-irrigates the whole field without any lateral ditches. Of course, this occurs only in peculiar soils. Its best exemplification is in Fresno and Tulare Counties, California. Sometimes a single ditch, nearly straight, will in this way irrigate one hundred and sixty acres.

The other method is exactly opposite. The whole field is flooded. Head-gates are placed along the main ditch, and from every head-gate a dike or levee is run across the field. Levees are also run along the sides, one of them forming the outside of the ditch. If these levees ran at right angles, a field thus prepared for irrigation would look for all the world like a huge printer's case. The levees may be two to four feet high. The intervening spaces are called "checks," and may contain any amount of land. I have seen one thousand acres cut into checks of from one to ten or twenty acres. I did not see how it could pay. Nothing was grown but hay and pasturage.

The checks are leveled, if not already sufficiently level. They are flooded one at a time. In flooding check No. 1, head-gate No. 1 is opened and No. 2 closed. As soon as the whole surface of this check has been covered with water, head-gate No. 2 is opened, and the same flood runs back into the ditch and down into check No. 2, and so on. The water is kept on the land but a short time. In warm weather the flooding is done mostly at night. The basins or checks formed by the dikes are not filled with water.

Alfalfa hay is cut four or five times a year, and the land is flooded after each cutting. Twelve tons a year per acre are not a rare crop, though less is commoner than more. For wheat and other cereals one good flooding is enough.

A good deal of California land has been over-irrigated. Alkali has been brought on or brought up, the soil has been made heavy, pools have been formed from the "seepage," and orchards and vineyards have been spoiled. After a field has been irrigated for a few years it becomes saturated, and wells dug in it soon reach water. It no longer needs so much water, and its former supply may be carried on to reclaim new deserts. How much a single river will reclaim, only give it time enough, can be vaguely guessed. Thousands of acres in the San Joaquin Valley have been placed beyond the need of further irrigation. The whole valley was once a desert.

A part of it seems beyond the reach of any irrigation except

what can be done during the rainy season. The Coast Mountains do not furnish living streams, and the Sierra Nevada water must run up hill to cross the valley and climb the western slope. How to get it over there is a problem vexing many minds. Several companies have been formed, and surveys have been made, for doing the work on different plans. One company proposes to lay iron pipes about fifty miles, at a cost of several millions of dollars. Another would carry the water in an open ditch above ground. At the lowest part of the valley-trough the ditch would have to be at least fifty and ought to be at least one hundred feet above ground, for several miles.

Under a new law of California, irrigation districts may be formed, and a vote taken as to what, if any, mains shall be constructed. A majority of residents rules. The minority, if they own land, help foot the bill. So do all non-resident land-owners. The district where these great iron pipes aforesaid are proposed would contain about eight hundred thousand acres. It was estimated that five dollars an acre would pay the cost. A gentleman interested as a landholder, however, assured me that his honest estimate would be not less than two hundred dollars an acre. With plenty of water the land, now practically worthless, would be well worth one hundred dollars an acre.

It will be readily admitted that such gigantic schemes of irrigation as these must raise new questions of both civil law and political economy. The constitutional conventions of the newly admitted States spent some time in wrestling with the problem of water rights. In all our arid regions property in land involves property in water. If by going higher up the river or cañon your neighbor may divert and use the water you have depended on, he might as well be permitted to take your land also, for it is valueless without the water. Litigation over these water rights has already given the California courts much to do, at heavy expense to litigants.

The rights themselves vary. In some cases one man or corporation owns the water, while another merely has the perpetual right to a share of it on the payment of a reasonable rate. But this right pertains to a particular body of land, and not to the person. In other cases each landholder is a shareholder in the water company. The difference appears on the face of the stock certificate. In the former case the name of the association which has tapped, say, the Alpine Cañon, will be "Alpine Water Company," while in the latter case it will be "Alpine Land and Water Company."

There are a good many of these land and water companies composed of farmers. Here is a new element introduced into farm life—an element of business and of co-operation. Sometimes it

involves also an element of clannishness; as, when two such companies fall to fighting over the same supply of water. In fact, as I have already observed, this necessity of irrigation will make the deepest of all the differences in personal character and habits of thought between the East and the West. Nobody will doubt that the institution of property in land has an important influence on character. Why not, then, property in water? And while this may be said to exist in the East, it is rarely thought of, while in the far West it is the thing most thought of and talked about. It is the main factor in human sustenance.

The result is bound to be that East and West will take different views of life. Hence they are likely not to understand each other. At present this makes the less trouble, from the fact that the East can so easily outvote the West. I mean, of course, the arid West. I think it a safe proposition that, when the country is all settled to a density everywhere corresponding with its fertility, the arid lands will outvote the regions needing no irrigation. And long before that time they will hold the balance of power.

Already the irrigants have secured from the non-irrigants the concession of an appropriation for surveys, and the appointment of a senatorial committee, which is now on its travels, studying the advisability of a great system of irrigating reservoirs to be built, or at least surveyed, at national expense; and in the latter case the demand will doubtless be for such disposal of the affected public lands as will make it worth some private citizens' while to construct the reservoirs.

The desert-land act was intended to be a step in that direction. Under that law, the man who irrigates a square mile (six hundred and forty acres) of desert land within three years after filing his entry, may buy it at one dollar and twenty-five cents an acre. It must be land not capable of producing crops without irrigating, and twenty-five cents per acre must be paid at the date of entry. By the operation of this law, and by purchase of adjoining railroad lands, a single firm has acquired the ownership of four hundred thousand acres of as good land as ever lay out of doors. The owners have carried over it the most gigantic system of irrigation on this continent. They have divided up the waters of Kern River, and spread them out into a great artificial delta. They have now begun to sell their lands in small lots of ten, twenty, forty acres, and so on. I attended one of their auction-sales, and saw land, which ten years ago was uninhabitable desert, knocked down at fifty, a hundred, and even a hundred and fifty dollars an acre. The water rate is extra, and is so much per inch used. An inch is the amount that will run through an orifice an inch square in the course of a year, under a four-inch pressure.

The desert-land act was not intended to put such large bodies of land in the possession of so few men. But any law is apt to work that way. Where the stock of the water company is held by all the land-owners using, the land is often hypothecated as security for the assessments, and in default of payment could only fall into the company's hands. What sort of land monopoly will grow up under it, the whole business of irrigation is too new to foreshadow. There is a bitter feeling already against certain large owners and syndicates. But it is doubtful whether the still heavier enterprises of damming waters up in the cañons will ever be carried out by private purses, unless those who go into them are well assured of fee simple in still larger bodies of land. And that, I judge, is about what far Western people mean when they say they don't want the Government to dam the waters, but only to "encourage private enterprise."

The landscape effects of some of these irrigating systems are quite striking; sometimes pretty and sometimes depressing. Many of the main ditches are fifty feet wide. Such a stream of water, or a much narrower one, must form no insignificant part of the picture on the eye of the traveler. If it is straight, sluggish, green, bare, it may be a nightmare in its oppressive ugliness. But where it winds about like a natural stream, as it often does in order to keep on high ground, and is shaded by trees planted hap-hazard along its banks, it is a thing of beauty.

You drive along a lovely lane, lined on both sides by tall poplar-trees, between fertile fields, gardens, orchards, shady groves, and now and then you come to one of these artificial brooks. You may have to go up hill to cross it. In fact, the sides of the ditch are naturally and properly above the level, so that the water will run out over the land. So you have the funny sensation of crossing a creek on a hill-top, and even then driving upward to get over it. The bridge is natural as life, and likewise the mill-dam and the mill. A drive through the country between Hanford and Fernone is as pretty as the imagination can picture it. Its beauties are wholly artificial. Ten years ago that was a desert; to-day it is ahead of the Mohawk Valley in everything that goes to make a fine-looking agricultural region. Its one fault as a landscape is that it is as level as a billiard-table.

It is a disputed question whether irrigation induces disease. Certain it is that the irrigated portions of the San Joaquin Valley are malarious. But Mr. Nordhoff says they are less so than before they were irrigated. I have talked with some hundreds of the inhabitants, and they seem as a rule to think otherwise. They do say, however, that there is an improvement in the general health since they learned to drink deep-well water instead of the surface water which seeps through from the ditches. Some neighbor-

hoods have artesian water. The whole valley is hot as a furnace, and the steaming canals probably make it seem hotter than it would, and may breed malaria as well as frogs and mosquitoes.

The Secretary of the Interior is reported to have sent an agent to Europe to study the subject of irrigation. We have a corps of engineers and a senatorial committee studying it in America. On the whole, it looks as if we ought to find out something about it. I have made a special study of it, and find it quite interesting. There is, perhaps, no more striking application of science to agriculture. You must know how to compute the mass of water that will flow through a ditch of a given size with a given fall. You must also know how much water will irrigate your particular piece of land. This will depend on its character as well as its size, and also on its annual rainfall.

It is astonishing how much the commonest Californians know about rainfall records. Rain-gauges are kept everywhere. The morning after a shower the farmers, instead of merely informing one another that it has rained, fall to talking of the quantity—and there is a good deal of sense in that. "My gauge showed fifty-seven hundredths of an inch," says Farmer Jones. "That makes 11·24 inches we have had this season," says Farmer Brown; "last season up to this time we had 13·42." And then they discourse of the precipitation yet needed to produce a crop without irrigation, or with partial irrigation, and the amount of irrigating water that will be required. The morning paper will give the rainfall in hundredths of an inch for a number of points throughout the coast country.

The size and strength of dams, head-gates, levees, etc., are matters requiring mathematical calculation of a delicate kind. Johnstown tells with terrible earnestness how important it is that these calculations should be to the last degree accurate. A careful survey of the route of each important ditch is also necessary. In fact, a number of sciences are involved in irrigating, but "practice makes perfect." Little by little the Western farmers are learning to depend more on cultivation and less on irrigation. They find it better in many ways; they now irrigate a greater area with the same amount of water. This hastens the day when the much-talked-of storage will pay.

What ought the Government to do in the premises? Tax the East to dam the West? I should say not, unless the expense were recouped. Perhaps it might construct the works and increase its prices on the land benefited. It gives lands to railroads in alternate sections, and then gets even by doubling the price of its own lands. What sort of a plan would it be for Uncle Sam to follow the example of the land-operators above mentioned—irrigate his land and sell it off at auction? He might sell it on sealed bids.

I should not much wonder if he could in this way make a handsome speculation.

Since the above was written, I read in the dailies that Secretary Noble has been informed that speculators are following in the wake of the Government surveyors, and trying to secure land and water titles; and that the Land-Office has been instructed to inform its registers and receivers throughout the arid regions that no such business will be allowed, but that the Government will retain control of these rights. This is a matter of several hundred times more importance than one Eastern man in a dozen will dream of.

PALM-TREES AND THEIR USES.

By M. J. POISSON.

AFTER the grasses, with their various adaptabilities for the purposes of food and the arts, the palm-trees hold the first place; and this, not only on account of the uses for which they are fit, but also by reason of the beauty and amplitude of their foliage and the stately size which many of them attain. Their worth in decoration and their usefulness have been celebrated in all times and in many languages. In the time of Linnæus, eight or ten species, belonging to half a dozen genera, were known. At this time the number of determined species exceeds a thousand, and these are distributed among about one hundred and thirty genera. In a short article like this we can only touch upon the subject and indicate the principal useful species.

The date palm was the one of most interest to the ancients. It is the fortune of the peoples of northern Africa and the ornament of the oases of that region. It sports into numerous varieties, which are easily obtained from the seed. When quarrels arise between tribes, the first thought of the hostile factions is to ruin their enemies by attacking their date crops. The male and female flowers being borne on different trees, a few male plants are sufficient for the fecundation of a great many females; and the destruction of the former—not a very hard task—will make the latter worthless. Date-trees the fruits of which are not palatable are used for building purposes, or for making palm-wine—the fermented sap, which is drawn from the tree by tapping it as we tap maple-trees. The sap is also much drunk fresh, when the Arabs call it *lagmi*. The dates are eaten directly, or their expressed juice is used for sirups and flavorings. Those which, because of being grown too near the sea or in unfavorable situations, as at many places in the regency of Tunis, do not become fully ripe, are mixed with bread and fed to horses and cattle.

The dwarf palm of Algeria and southern Spain (*Chamærops humilis*) is not a profitable sort, but is rather a detriment to the Algerian plains. When it gets possession of a spot, it is very hard to exterminate, and the place becomes little to be preferred to the desert. The palm lands have, however, been cleared to a considerable extent since the French occupation of Algeria. The leaves are used in making brooms, baskets, and minor articles, for paper pulp, cords, and "vegetable hair."

The tender, plump buds of many species of Indian and American palms supply a choice food which is called "palm cabbage." The young tissue, which is very like salad-heart, is eaten raw or cooked and seasoned in different ways, or pickled. The leaves that are large enough are used on the roofs of houses or in the manufacture of a diversity of articles. Hindu characters are sometimes traced with a bodkin on strips of the leaves of the fan palm (*Corypha*) of the Indian islands, and these are folded like letters and sent in the mail. The flexibility of the leaves adapts them to many purposes of art. From the young leaves of the coco (*Lodoicea seychellarum*), whose enormous and strange-looking fruit is an object of curious interest, the natives of the Seychelles Islands make some handsome basket-work. The extremely light and durable hats called Panama are made from the leaves of species of this family. The pellicle of the leaves of the *Raphia*, or sago palm of Madagascar, from which the natives of that island make fine cloths, is used for ties in gardening and in the manufacture of artificial flowers, and is good for many other purposes.

Bridges over torrents and small rivers are made of the solid trunks of palm-trees. When the wood is fine and close, it is split into pieces that are turned and polished. Highly esteemed umbrella-handles — called laurel handles—are made from several kinds. If the central part of the stem is filled with tender pith, not too much stringy and tough, it is collected as sago; of which the sago palm of Madagascar and the corresponding regions of Africa affords the most highly prized quality.

Stems of small diameter are equally desirable. The jungles in the East Indian Archipelago—Java, Sumatra, and the peninsula of Malacca—abound in climbing palms or palm vines, the stems of which wind among the limbs of the trees to the top. Some have been measured that were a hundred yards long before they became interlocked with the network of the forest. They are the rattans (Fig. 4) which are so handy where a cane or any kind of flexible stick is wanted. Chairs are caned with the outer part of the rattan, and from the rest of the stem children's chairs, baskets, and many useful articles—including even dish-cloths—are made. The author of this essay has had considerable success in making such ornamental articles as earrings, scarf-pins, etc., out of the

handsome fruits of some of the rattans. And the continued abundance of wild beasts, like the tiger, etc., in the East Indian forests, in spite of the activity with which they are hunted, is

FIG. 1.—ARECA LUTESCENS—a young specimen in pot, to show the ornamental character of small palms.

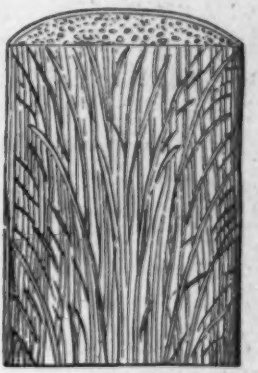


FIG. 3.—PALM-STEM IN SECTION.

FIG. 2.—INFLORESCENCE AND FRUIT OF PALM. 1. Spathe and portion of spadix of Chamærops. 2. Staminate flower. 3. Pistillate flower. 4. Fruit. 5. Seed. 6. Seed cut vertically.

FIG. 4.—RATTAN PALM (*Calamus rotang*).

explained by the growth of rattans which make the jungle impenetrable to hunters.

Some palm-trees furnish a sweetening juice. The most famous

of these is probably the *Areng*, or sugar palm of Amboyna (*Arenga saccharifera*), which grows in India and the archipelago. It is a superb tree, with pinnate leaves twenty-five feet long, and is as handsome as it is useful. A number of species belonging to different genera furnish a kind of hair of finer or coarser texture. It is found in the fibrous sheaths of the leaf-stalks and in the jagged edges of the leaves. Cables made of the black, tough fibers of the *Areng* are preferred by the coasting sailors of the Spanish colonies on account of their elasticity and durability; and they are, moreover, very fine. The hemp palm of Japan and China (*Chamærops excelsa*, Fig. 5) is available in the hands of the industrious people of those countries for making the finer brooms, light strings, and a thousand articles of daily use. Palms of coarser fiber, like the *Piaçaba* of Brazil (*Leopoldina piacaba*), furnish material for blinds, brushes, brooms, and the rollers of mechanical sweepers, which are much more durable than rollers fitted with steel teeth. A waxy exudation forms on the trunks of the wax palm of the Andes (*Ceroxylon andicola*) and is collected by the natives for purposes of illumination. The *Carnauba* of Brazil (*Copernica cerifera*) forms a cerous efflorescence on the inside of its leaves. The natives climb upon the trees of the latter species and beat the leaves with rods, when a fine snow falls from them and is collected on cloths spread upon the ground for the purpose. The wax of the *Carnauba* is used in commerce, both by itself and associated with other similar substances.

FIG. 5.—CHAMÆROPS EXCELSA.

The fruits of the palm are inferior to none. Every child knows what Robinson Crusoe did with his cocoanuts. After dates, this is the most generally diffused fruit of the palm. No drink is more in demand among the creoles and blacks than the milky kernel of the green cocoanut. When the fruits reach us, the albumen has hardened and become somewhat tough and indigestible. This nut is one of the sources of wealth—in some cases, perhaps, the only one—of the coral islands of Oceania and some other tropical regions. With the top in the sun and its roots bathed by the seawaters—its favorite station—the cocoa-tree (*Cocos nucifera*) continues in good condition to the age of seven or eight hundred years. The dry nut, called *copra*, is marketed by the thousand tons every year, to be employed in various uses for which fats are

FIG. 6.—CABBAGE PALMS IN THE "SAVANNAH" OF CAYENNE

wanted. The thick, fibrous envelope of the nut has been much used of late years in Europe. After being macerated, the fibers, called *coir* or *cair*, are combed. Ropes made of them are elastic and hardy against decay. They are worked into articles of esparto and brushes, and we tread them under feet in cocoa mattings. From the hard shell of the nut are made cups and dishes, which are susceptible of a ready polish, and can be carved. The leaves can be utilized, like those of other palms, but lack the suppleness of the leaves of other kinds.

Not all the species of *Cocos* bear fruits as large as those of *nucifera*. The small species also contribute to the maintenance of man and industries. A considerable trade is carried on in the little cocoa of Central America (*Cocos lapidea*), which is sometimes called the "convicts' cocoa," because prisoners polish or carve the hard egg-sized shells of the nuts, and make of them balls for mending stockings, bead-boxes, tobacco-boxes, and toys to sell to visitors. The same shell is in favor for making fancy buttons.

Some other species of palm bear eatable or oleaginous fruits. The reddish-yellow, acorn-shaped fruits of the *Paripon* of Guiana (*Guilielma speciosa*) is highly esteemed. It is cultivated under different names in all the Central American countries. Beverages, and often alcohol, are obtained from the fruits of several other species. The *Avoira*, or oil palm, of Africa (*Elæis guineensis*) is, after the cocoa, the most important of the palms as a commercial object. The numerous fruit-clusters of this palm, twice as large as a man's head, contain many fruits of the size of a walnut, the external envelope of which is charged with "palm-oil," a fat that is much used in soap-making, and is esteemed by Africans as an aliment. The kernel of the fruit affords an oil superior in limpidity and savor to that of the pericarp. The African product of avoira fruits is estimated at one hundred thousand tons a year.

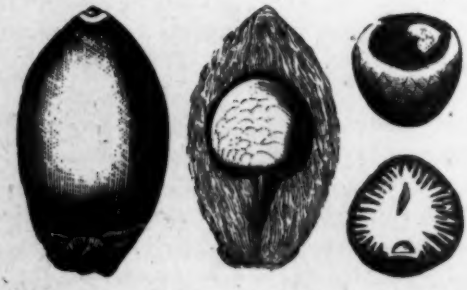


FIG. 7.—FRUIT AND NUT OF BETEL PALM, ENTIRE AND IN SECTION.

The manufacture of textile fabrics from palm-leaves has not been fully experimented upon. A few Central American palms and the oil-palm afford a strong and very fine fiber.

Horticulturists have made much of palm-trees, and they are now abundant in the flower markets. The Bourbon palm (*Livistonia sinensis*); date palms of several species; dwarf palms and

the tall *Chamærops;* the *Corypha;* Weddell's cocoa, and two or three other species, are common as room ornaments. Other species do not bear the close air of apartments well, and are very liable to die if taken from the greenhouse or conservatory.

Fig. 6 represents an avenue called the "Savannah of Cayenne," which is composed of the straight-stemmed cabbage palm (*Oreodoxa oleracea* of the Antilles), and has been much admired by travelers. Whenever one of the trees is blown down, or removed by any other cause, another one is at once planted in its place.

Palm-trees rarely grow in numbers together. There are, however, groves of a few species. The *Attalea excelsa* of America, which grows to the height of more than fifty feet, forms small woods. The *Oreodoxa oleracea*, or cabbage palm, is one of the largest species known, with its head often rising above the foliage of the virgin forest. Specimens of it have been found by measure to be about a hundred feet high, and the royal species of Havana rises to nearly one hundred and twenty feet. These plants are for the most part evergreen. They do not love climates of intermittent temperatures and abrupt changes, except in rare cases, of which the *Areca* palm of India (*Areca catechu*) affords an example. This species is extensively cultivated in the Indies, where the firm and astringent kernel of its nut (Fig. 7) is chewed with the betel-leaf by every native, as other people smoke or chew tobacco.

A considerable number of fossil palms have been found, chiefly in the Miocene Tertiary of America, India, and Europe.—*Translated for the Popular Science Monthly from La Nature.*

A HARVEST FROM THE OCEAN.

By Prof. C. MORTON STRAHAN.

THE compensations of nature are nowhere more forcibly illustrated than along the bleak and rugged coasts of Scotland, Ireland, and Brittany, and their adjoining islands. Towering cliffs, whose scarred faces show no sign of verdure and defy all hope of cultivation, clasp the deeply indented bays in rude embrace. Hamlets by the score hide themselves in the more sheltered nooks, and the inhabitants find a precarious living by following the sea. Amid such unpromising surroundings Nature yearly plants and nourishes beneath the waves and along the wave-washed rocks a bounteous crop of sea-weed, which proves a genuine blessing to the dwellers on those shores. Not only is this both planted and nourished by the ocean, but it is to a great degree harvested by the same hand, and laid ready for use at the very doors of the fisherman's hut. The terrible storms which drive

the venturous seaman against hidden rocks, sweeping ashore his lifeless body and dismembered ship, also tear up great quantities of this valuable weed from the ocean's bed and dash them in continuous bulwarks high up on the beach. Thus thrown ashore during the winter and early spring is a mass of what the natives call "deep-sea tangle," but which in the hands of the naturalist is recognized as a mixture of two kinds of *Algæ*, termed respectively *Laminaria digitata* and *Laminaria saccharina*. In the spring and fall the milder storms add the "tangle-top" to the winter harvest. The tangle-top, as its name implies, consists of the tops or fronds of the same plants whose stems compose the "tangle" proper. These self-gathered masses constitute the greater bulk and the more valuable part of the annual yield. Together they are known as "drift-weed," as opposed to three varieties of *Fuci* (more commonly known as wracks) which grow on the rocks in that area covered by the rise and fall of the tides, and which, from the manner of their gathering, take the name of "cut-weed."

Recourse must be had at this point to chemical analysis to reveal some useful ingredient which may justify this wet, salty, ill-odored mass of vegetable matter being dignified by the name of a crop. The analyses of the several species of *Laminaria* and *Fuci* show considerable variations; it may, however, be taken that of the ordinary mixed mass of wet tangle and cut-weed about eighty per cent is water, fifteen per cent organic matter, and five per cent ash or mineral matter. In the same way it may be admitted that one hundred pounds of the ash will contain, approximately, twenty pounds of insoluble material, fifty pounds of alkaline carbonates and chlorides, twenty-two pounds of potash and soda, 6·5 pounds of sulphuric acid in combination, and 1·5 pound of iodine in combination as iodides of potassium, sodium, etc. One hundred and fifty years ago such an analysis had never been made, nor would it have possessed any of its present suggestiveness, for at that time iodine had not yet been discovered, and the burning of sea-weed for its ashes was practiced to but a very limited extent. It required the pressure placed upon the soap-makers of France and England by the wars of the great Napoleon to force practical and wide-spread attention to the ashes of sea-weed. In virtue of that pressure the foreign supply of soda and potash salts in both of those countries was entirely cut off, and every domestic substance was ransacked for its contents of alkalies. This gave rise to that general movement among the Scotch and Irish peasantry which resulted in the annual burning of the sea-weed harvest, and the introduction of a new commercial body under the name of varec or kelp.

Though the absolute yield of the alkali salts was small (about

fifty pounds to one ton of the wet weed), so complete was the embargo against Spanish barilla and salt that kelp assumed a value as high as one hundred dollars per ton. During this halcyon period Scotland and her western isles reaped an annual income of nearly three million dollars, a sum which raised to affluence many a Scottish lord whose sole possession hitherto had been a long title and a few miles of barren sea-shore. But the end of the war, and the success of Le Blanc's process for making sodium carbonate out of common salt, brought down the value of kelp with a sudden and disastrous drop. In 1831 the price had fallen to ten dollars per ton, a figure no longer remunerative. At this period kelp-making would have died out entirely but for the presence in it of a small quantity of iodine. The discovery of that element in 1812, by Courtois, and the demands for its manufacture, which had arisen between that date and 1840, were the sole cause for the continuance of kelp-making; for kelp was then, and has since remained, the only practicable source of iodine in Europe. During the past fifty years kelp has furnished fully ninety per cent of all the iodine and iodides which commerce has handled. The remaining ten per cent comes from South America, being derived from the well-known *caliche* of Peru. This substance, in being worked for the large amount of nitrate of soda it contains, also gives a small quantity of iodine as a profitable by-product. The *caliche* yields from two to three pounds of iodine per ton, against an average yield of twelve or fifteen pounds on the part of kelp. Many bothering questions of manipulation increase the labor and cost of the product from the former source, thus leaving the commercial advantage with kelp. With the origin of this new demand for kelp the industry received a strong impulse, and the price was restored to fairly profitable figures, ranging from fifteen to twenty dollars per ton, at which price it is still in commerce.

It may be proper to note several interesting facts connected with the growth and composition of iodine-bearing weeds. All sea-weeds do not contain iodine, although that substance is universally present in sea-water in the ratio of one to two hundred and fifty thousand, proportions which, though minute, are amply sufficient to tempt assimilation by all growing sea-plants at least to an appreciable extent. Yet very few of them outside the family of *Algæ* contain even a trace of that element. So that to this family has been committed the chief work of withdrawing iodine from sea-water, and of concentrating it in plant-tissues in a form easy of extraction. The power of iodine absorption on the part of the *Algæ* is the more remarkable when it is remembered that their growth transpires in the presence of three hundred times as much of the very similar element bromine, which latter, however, is absorbed in only one tenth the quantity. The localities where they

grow, as well as the number of iodine-bearing plants, are very limited. The shores of the British Isles and of Brittany are the spots most favored, owing to the presence of the Gulf Stream, which serves as the carrier of the iodine and of the temperature conditions necessary to the growth of the *Algæ*.

By far the larger portion of the sea-weed harvest comes ashore in the early spring and in the late fall. The fall harvest, together with that which winter adds, is suffered in most localities to lie untouched on the beach until it has been carried out to sea again and lost forever. It is only the spring crop which receives special care. Thousands of women and children, and a small sprinkling of men, may be seen flocking to the beach during the month of May, armed with rakes and wheelbarrows, or driving low carts, whose wheels are made broad enough to prevent their sinking in the sand. The wet weeds are raked into piles, and carried either by barrow or cart to a conveniently safe distance from the water's edge. Usually a sheltered nook is chosen, if near at hand, and in it is stored a great mass of the weed. Here it is left to dry under the summer's hot sun, meanwhile exhaling odors of no dainty description. There are well-recognized liberties and restrictions in regard to sea-weed accorded to landlords and peasantry who dwell along the shore. The landlords have most of the liberties, while the peasants enjoy the restrictions. Conflicts of sea-weed rights have been known to occur, in which cases the shillalah has had an important share in the gathering of the crop.

When the weed is dry—that is, in the latter part of July and the first of August—the owners of the sea-weed heaps undertake to burn them into kelp. This burning is done in the crudest and most wasteful manner. Shallow pits, often dug right in the sand, are filled with weed and the mass ignited. Upon the first charge fresh quantities of weed are thrown from time to time, the whole mass burning more or less rapidly in proportion to the dryness of the weed. There results, in the bottoms of these pits, a black mass resembling iron-slag in appearance, though not in hardness, which, being sprinkled with water while hot, breaks up into large lumps suitable for transportation. Owing to the carelessness with which the weeds are raked up, this crude kelp-slag always contains a large percentage of sand and other impurities, sometimes amounting to one half the total weight of the product. The improvidence of this is the more marked in view of the small amount of valuable salts which even at best can be found in the kelp, and the rapid ratio in which the cost of transportation diminishes the profits when half of the slag is dead weight. The improvidence extends equally to the burning itself. This takes place in full access of air, and at a temperature so high as to volatilize much of the iodine. Besides, all the gaseous products of the

combustion are lost and the escaped gases overcloud whole townships, and impart to miles of sea-shore the peculiar odor characteristic of burning kelp. To save these gaseous products by distilling the weeds in closed retorts, at low temperatures, would mean the production, at little extra cost, of valuable amounts of ammonia, parafin, acetic acid, naphtha, etc. In addition, the charcoal left would be much richer in iodine than the ordinary kelp, and its mechanical form much easier of subsequent extraction. Attention has been called time and again to the enormous waste of material and the easy means of improvement in kelp-making, but thus far little inroad has been made into this European species of ancestor-worship. The crofters cling to traditional methods and primitive tools.

When kelp, such as has been described, is brought into market, it is purchased by those directly engaged in making the salts of iodine and the alkalies. In their hands it becomes the subject of careful treatment to separate the valuable ingredients from the gross impurities with which they are associated. This is commonly done by breaking the kelp into small lumps and lixiviating in suitable vats filled with hot water or supplied with steam vapor. Such treatment, when sufficiently prolonged, dissolves out the alkaline and iodine salts, which need only the subsequent operation of being allowed to settle and siphoning off to separate them from the insoluble matters. The liquor contains chiefly the chlorides, the sulphates, the sulphites, and the hyposulphites of sodium and potassium, as well as the iodides and bromides of those metals. By evaporating this solution, the greater portion of the chlorides and sulphates will crystallize out before the iodides, bromides, and lower sulphur compounds begin to deposit. The former may then be fished out of the evaporating pan, leaving a resultant mother-liquor rich in iodides. The hurtful sulphur compounds remaining are decomposed by excess of strong sulphuric acid, and then the proper quantity of manganese dioxide is added. This mixture is transferred to an iron retort and heated, the result of which is to liberate the iodine and part of the bromine present. The vapors of these elements are conducted into proper earthenware condensers, where the iodine is deposited as a black powder, and the small quantity of bromine as a dense brown liquid moistening the iodine powder. As before indicated, from twelve to twenty pounds of this crude iodine are obtained from the mother-liquor of one ton of kelp. There are several possible ways of purifying the crude iodine, in order to secure the iodine of commerce and also the bromine which had been its chief impurity. Even this purified iodine contains minute traces of bromine, owing to the difficulty of their perfect separation. If iodide of potassium is desired instead of free iodine, it is still necessary to produce

the latter, and from it obtain the iodide by the action of potassium hydrate or caustic potash.

Iodine, as a commercial body, has been subject to great fluctuations in price. It has ranged from a minimum of $1.50 to a maximum of $9.50 per pound, and is at present quoted at the fairly constant figure of $4 per pound.

This harvest of sea-weed, whose transformation into iodine has been briefly traced, has been to a certain extent the subject of other industrial applications. In Ireland and the Channel Islands the weeds are used directly as a fertilizer. Its advantages in this line are chiefly felt in the Irish potato crop, where the potash of the sea-weed supplies a most important ingredient of that staple tuber. The presence, also, of small proportions of the earthy phosphates increases its value for fertilizing purposes. Attempts have been made to utilize these weeds in the manufacture of paper and textile goods, but with little or no success, owing to the fact that the true *Algæ* are not fibrous in their structure; nor is it surprising to find sea-weed quite extensively used as a fuel among a tenantry so poverty-stricken, and in a country so bare of combustibles. But the chief value of the sea-weed harvest remains in the monopoly of iodine which its tissues possess.

Despite its many wasteful drawbacks, the kelp industry shows the respectable annual yield of six million dollars, much of which finds its way into the pockets of a very destitute tenantry. In those districts where the winter supply is carefully gathered and burned, the production of kelp has had very beneficial effects by employing and remunerating the most indigent classes at a time when they would otherwise be totally unproductive.

BIRDS WITH TEETH.

By OTTO MEYER, Ph. D.

THE birds of our present world, however different they may be from each other in size, shape, color, etc., are remarkably uniform in their anatomical construction. Adapted to a life in the air, they all possess bones which are more or less pneumatic—that is, contain air-cavities, to lessen the weight of the skeleton. Altogether the reduction of weight has been brought down to perfection, and a flying bird carries very little, if any, unnecessary substance. Locomotion in the air requires, further, a vigorous action of the wings, and such a motion could hardly be executed in presence of a loose and shaky body. But the skeleton of the body of a bird is not loose; on the contrary, it is very solid. The vertebræ of the backbone are grown together and form a firm

column. With this column the broad ribs unite in the back, while in front they are held together by the sternum; and to make this cradle of bones more compact and fit to resist the action of the wings, and to protect the interior organs, the ribs touch each other with what the anatomists call "uncinate processes." Whoever is called upon to carve at the table a chicken or a turkey will experience how solid and protective the construction of the skeleton of the body is.

If the main body is in this way compact and immovable, some other part must be so much the more flexible, and this is the neck. If we watch a swan oiling its feathers with its bill, see the cervical evolutions of a flamingo, or an owl sitting with its head reversed, we are apt to experience a painful sensation in our necks and may wonder whether the bird will assume its normal position without breaking something. But all these motions are executed with the most perfect ease and security, and the construction of the vertebræ, which enables the birds to perform them, is simple and effective. These vertebræ do not articulate with each other by plain faces as the vertebræ in our bodies, but the articulations are saddle-shaped, so that the prominence of one vertebra fits into the excavation of the next one, and *vice versa*. If we take two adjoining vertebræ of the neck of a bird and try their motion, we shall find that this articulation admits two ways of turning—from one side to the other as well as up and down. This saddle shape of the articular face of the cervical vertebræ is found without exception in all existing birds and in no other animal.

FIG. 1.—VERTEBRA OF A BIRD WITH SADDLE-SHAPED ARTICULAR FACE.

There are other features which are met with in all birds and exclusively in them—for instance, the plumage. The horny bill is without teeth. The vertebræ of the tail are grown together and form a plowshare-shaped bone. This bone supports the tail feathers, which can be opened and closed like a fan, and which serve as a rudder and a parachute. The bones of the anterior extremities are transformed in such a way that they form an excellent framework for the wings; but, although the anatomists distinguish easily radius, ulna, digits, etc., one would hardly suspect that these wing bones are perfectly analogous to those in the fore-feet of quadrupeds, or in our arms and hands.

Now let us turn our attention to the reptiles which exist at the present time—to the lizards, crocodiles, snakes, and turtles. These cold-blooded, scaly animals seem to have nothing at all in

common with the warm-blooded, feathered inhabitants of the air; and yet our first scientists, for instance, Prof. Huxley, unite reptiles and birds as one class of animals. However closely we may study the anatomy of a chicken and of a crocodile, and search for points which are common to both, we shall be only moderately inclined to follow the example of these naturalists and consider birds and reptiles as near relatives. But we shall become convinced of their close connection if we study also their geological history.

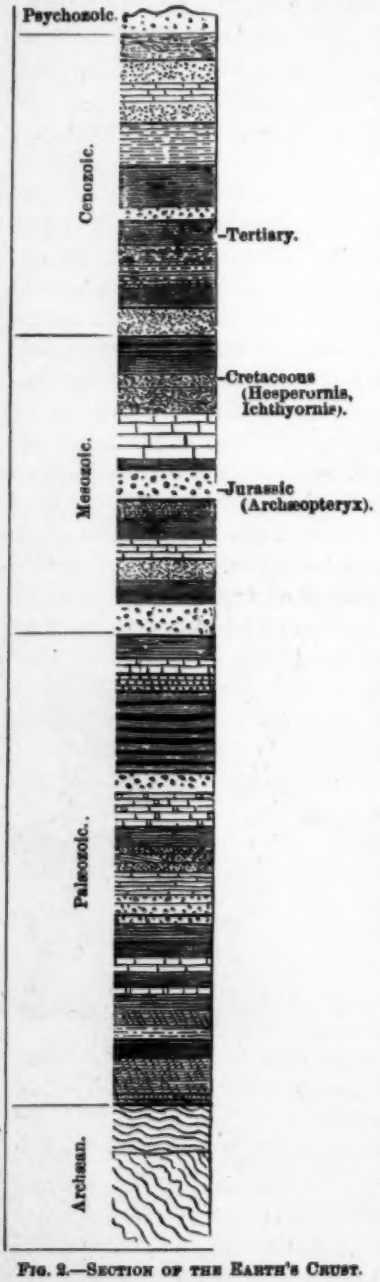


FIG. 2.—SECTION OF THE EARTH'S CRUST.

In the first instance, we then see that the reptiles of the present time are only small remnants of a once numerous and powerful tribe. In certain former geological periods we find reptiles to be the kings of the earth; we discover reptiles of enormous sizes; reptiles of all kinds of shape and anatomical construction; and among them there are some which resemble birds much more than does a crocodile or a lizard of the present day. In the second instance, if we look at the birds of former periods we find that, in the same way as we go backward in the history of our earth, these former inhabitants of the air differ more and more from the specialized pattern after which all our present birds are built, that they become more and more reptile-like, and that there can hardly be any doubt that the birds are indeed branched off from the great reptilian trunk of the animal kingdom.

There are three fossil birds of pretertiary age known almost completely; two of them were found in the Cretaceous formation of North America, and one in the Jurassic formation of Germany.

During the Cretaceous period the Rocky Mountains were not yet the high elevation which they are now, but were existing probably only as a succession of low islands. The land of several States of the Union was deposited at that time at the bottom of the ocean, east of this line of islands. One of these States is Kansas, in which, therefore, the cold water was then still more supreme than it is now. In the Cretaceous deposits of Kansas the remains of the bird *Hesperornis* have been found. It was a

FIG. 3.—HESPERORNIS REGALIS (restored by Marsh).

large animal, about five feet long, with well-developed, strong legs, but perfectly obsolete wings. The anatomical construction indicates the way of living. It was entirely without the power of flight, living in the way of penguins, mostly on the water, diving for fish, which it was admirably adapted to catch, and with which the Cretaceous ocean here was teeming. The shores were visited probably only for the purpose of breeding. There is nothing very peculiar in its anatomy, with the exception of one fact, which, however, distinguishes it at once thoroughly from all birds living now: its long bill was provided with teeth, teeth which resemble those of reptiles. Few discoveries have at their time caused so much interest among geologists as when through

Kansas fossils the fact was established that birds with teeth formerly existed.

The deposits of Kansas in which the *Hesperornis* has been found have yielded also the remains of another Cretaceous bird,

FIG. 4.—RESTORATION OF ICHTHYORNIS VICTOR (after Marsh). One half natural size.

the *Ichthyornis*. This animal was small, of about the size of the tern, and probably also resembled it in its habits and mode of living; at any rate, it was a good flier, with powerful wings and small legs. The *Ichthyornis* also had teeth in both jaws. But in still another respect it was different from all our present birds. The articular faces of its vertebræ were not saddle-shaped, but simply excavated on both sides; they were biconcave. This form of vertebræ is met with in a few recent and many extinct reptiles, and in the amphibians. But it is especially characteristic of fishes, and the name has been chosen on account of it, for *Ichthy-*

ornis means "fish-bird." The fossil remains from which *Hesperornis* and *Ichthyornis* have been described are exhibited in the Museum of Yale College, in New Haven.

A long time, a whole geological period, before *Hesperornis* and *Ichthyornis* were enjoying life and eating fish on the vast Cretaceous ocean of the western United States, there was on the other side of the Atlantic, at about the site of the town of Solenhofen, in Bavaria, a lake or marine gulf in a protected situation, with very quiet waters. The lime carried by the rivers into this gulf was deposited at the bottom, in an exceedingly uniform and undisturbed manner, as a very fine sediment. At present, after millions of years, the gulf is dried up and the sediment has been hardened to a limestone, the grain of which is unusually small and regular. In fact, no limestone in any country

FIG. 5.—CERVICAL VERTEBRA OF ICHTHYORNIS DISPAR, × 2.

FIG. 6.—ARCHÆOPTERYX MACROURA (Berlin specimen).

surpasses, or even equals, this Jurassic limestone of Bavaria in this respect, and therefore the lithographers of the whole earth receive their lithographic stones from the quarries of Solenhofen. We may obtain an idea of the exceptional and uniform way in which this limestone has been deposited when we see the impressions and casts of jelly-fish and other delicate animals, which are found as fossils in this stone and in no other known deposit.

In this lithographic stone of Bavaria there was found, in the

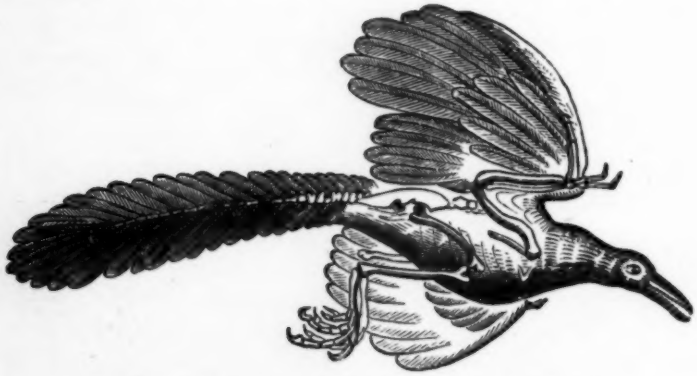


FIG. 7.—ARCHÆOPTERYX MACROURA, RESTORED (after Owen).

year 1860, the impression of a feather. This proved the existence of a bird during the Jurassic period—that is, of a feathered animal much older than all other known fossil birds. It was therefore named *Archæopteryx*, which means "old wing." The feather was there; a sharp lookout was kept now for the bird itself, and, indeed, one year later, a nearly complete skeleton of it was found. It was bought by the British Museum, in London, for fourteen thousand marks, and has been described by Prof. Owen, Sixteen years later, in 1877, a second specimen was discovered in Solenhofen. The electrician, Dr. Siemens, in Berlin, did not wish that this fossil should also go out of Germany; therefore he bought it for twenty thousand marks, and sold it afterward, at the same price, to the Prussian Government. It is now in the Berlin Museum.

Both specimens together furnish us with an almost complete picture of the Jurassic bird. The *Archæopteryx* was about the size of a pigeon. The Berlin specimen proves that its bill was also provided with teeth. Furthermore, the vertebræ show also that biconcave form, as in *Ichthyornis* and in lower animals. But there are a number of other features in the *Archæopteryx* which remove it still further from the birds of the present time, and make it resemble a reptile: 1. Its wing bones were not grown together in the way of all the other birds, but they were partially

separate, as in the fore-foot of a quadruped, and there were even three claws, so that the animal could also grasp with its wings. 2. Its ribs were small, thin, without uncinate processes, and therefore formed no compact and solid cradle. 3. Its pelvic bones were almost like those of certain extinct reptiles. 4. Its tail was not short, with a plowshare-shaped bone and a fan-like arrangement of the tail feathers, as in all other birds, but it was long, composed of not less than twenty vertebræ, and the feathers were fixed along the whole length of this tail. In other words, it was a regular lizard tail, but covered with feathers. It is no wonder that some scientists did not consider the *Archæopteryx* as belonging to the birds, but thought it was a reptile. Apart from its plumage, however, there is too much in its anatomy that is avian. At any rate, it was a very reptile-like bird, and its power of flight was certainly not great. It probably fluttered more than flew, and occasionally used its claws to support itself. The formation of its eye bones seems to indicate that it was of nocturnal habits, like our owls.

Other fossils, lying as yet unknown in the strata of our earth and waiting for the ardent scientific digger, will teach us considerably more about the evolution of the birds, but the outlines of it are already mapped out by what we possess at present; and it must be said, especially about the *Archæopteryx*, that it sheds more light upon the development of the animal kingdom during former periods than perhaps any other known fossil.

THE EFFECT OF CAVE LIFE ON ANIMALS, AND ITS BEARING ON THE EVOLUTION THEORY.

By A. S. PACKARD.

THE main interest in studies on cave life centers in the obvious bearing of the facts upon the theory of descent. The conditions of existence in caverns, subterranean streams, and deep wells are so marked and unlike those which environ the great majority of organisms, that their effects on the animals which have been able to adapt themselves to such conditions at once arrest the attention of the observer. To such facts as are afforded by cave life, as well as parasitism, the philosophic biologist naturally first turns for the basis of his inductions and deductions as to the use and disuse of organs in inducing their atrophy. It is comparatively easy to trace the effects of absence of light on animals belonging to genera, families, or orders in which eyes are normally almost universally present. As we have seen in non-cavernicolous

animals, the eyes are wanting from causes of the same nature as have induced their absence in true cave animals. No animal or series of generations of animals, wholly or in part, lose the organs of vision unless there is a physical appreciable cause for it. While we may never be able to satisfactorily explain the loss of eyes in certain deep-sea animals from our inability to personally penetrate to the abysses of the sea, we can explore caves at all times of day and night, of winter and summer; we can study the egg-laying habits of the animals, and their embryonic development; we can readily understand how the caves were colonized from the animals living in their vicinity; we can nicely estimate the nature of their food, and its source and amount, as compared with that accessible to out-of-door animals; we can estimate with some approach to exactitude the length of time which has elapsed since the caves were abandoned by the subterranean streams which formed them and became fitted for the abode of animal life. The caves in southern Europe have been explored by more numerous observers than those of this country, and the European cave fauna is richer than the American, but the conditions of European cave life and the effects of absence of light and the geological age of the cave fauna are like those of American caves. Moreover, the cave life of New Zealand and the forms there living in subterranean passages and in wells show that animal life in that region of the earth has been affected in the same manner. The facts seem to point to the origin of the cave forms from the species now constituting a portion of the present Quaternary fauna; hence they are of very recent origin.

The result of cave exploration shows that no plants, even the lowest fungi, with the exception of *Oozonium auricomum* Link, and perhaps one or two other kinds of fungi common to Europe and America in and out of caves, can so adapt themselves as to live and propagate their species in the total darkness of caverns. They are far more dependent on the influence of light than animals.

We will now briefly rehearse the facts relating to the changes in structure and color undergone by animals adapted to a life in total darkness in caves, premising that, so far as we know, the Protozoa detected in subterranean waters do not essentially differ from those living in the light. It appears from the following facts that eyeless animals change their color as well as those having eyes:

1. A sponge (*Spongilla stygia*) found by Dr. Joseph in the waters of Carniolan grottoes, instead of being green, is pellucid and bleached.

2. The Hydra (*H. pellucida*), also found by Dr. Joseph in the subterranean lakes of Carniola, was, as its name indicates, neither

green nor brown, like the two species of the upper world, but pellucid, bleached out, or colorless.

Such was also found by Dr. Joseph to be the case with the smaller crustaceans, such as certain cave species of Cypris, Leptodera, Estheria, and Branchipus (*B. pellucidus* Jos.).

3. As regards change of color, we do not recall an exception to the general law that all cave animals are either colorless or nearly white, or, as in the case of *Arachnida* and insects, much paler than their out-of-door relatives.

The worms (planarians and earth-worms) are somewhat paler than their allies living out of caves, but as the normal environment of most planarians and earth-worms is much like those of cave animals, the difference is not so marked, though both of our cave planarian worms are white and eyeless.

All the cave *Crustacea*, both aquatic and terrestrial, are colorless or whitish, more or less vitreous, and pellucid, the pigment cells being degenerate and functionless. The effects of total darkness seem quite different from the influence to which the eyeless deep-sea *Crustacea* are exposed, since they, like their fellows with eyes normal or hypertrophied, are said to be of the same flesh and reddish tints common to deep-sea animals.

In the case of the cavernicolous myriapods the bleaching of the body is very marked. In out-of-door myriapods the normal tint of the integument is brown or rarely amber-brown; but the color of the cavernicolous species is white or flesh-white, like a freshly molted myriapod of normal habitat.

The cave species of *Arachnida* are usually whitish or pale amber-colored, or pale horn, with a reddish tint. Of the mites, some are white, others horn-color, or chitinous. In the family *Chernetidæ* the cave species are "dull white," or "pale horn with a reddish tint," or "pale yellowish."

The effects upon the eyes and optic lobes of a life in total darkness are the following:

1. Total atrophy of optic lobes and optic nerves, with or without the persistence in part of the pigment or retina and the crystalline lens (*Cæcidotæa, Crangonyx, Chthonius, Adelops, Pseudotremia*).

2. Persistence of the optic lobes and optic nerves, but total atrophy of the rods and cones, retina (pigment) and facets (*Orconectes*).

3. Total atrophy of the optic lobes, optic nerves, and all the optic elements, including rods and cones, retina (pigment) and facets (*Anophthalmus, Scoterpes,* and ? *Anthrobia*).

An interesting fact confirmatory of the theory of occasional rapid evolution, as opposed to invariably slow action involved in pure Darwinism, is that we never find any rudiments of the optic

lobes or optic nerves; if they are wanting at all, they are totally abolished; there is not a series of individuals with these organs in different degrees of development corresponding to the rudimentary conditions of the eye. The atrophy is comparatively rapid, sudden, and wholesale. On the other hand, we have series, as in *Cœcidotœa* or *Chthonius*, where there is but a single, or two or three, or several crystalline lenses, partially enveloped in pigment.

These varying degrees of development in the peripheral parts of the eye prove that the animals entered the caves at different periods, and have been exposed for different lengths of time to the loss of light. For example, those individuals of *Chthonius Packardii* which live in the Labyrinth of Mammoth Cave are eyeless, or have merely pigment spots; those collected in the Rotunda (which is much nearer the entrance to the cave) have eyes, or at least lenses and a retina. While most individuals of the *Cœcidotœa* are eyeless, a few have rudimentary eyes. Thus, in the differing conditions of the eyes in different individuals, we have an epitome of the developmental history of the genus *Cœcidotœa* and its species. Certain *Aselli* borne into caves or introduced into subterranean streams feeding deep, dark wells, losing the stimulus of the light, begin to lose their eyes and the power of sight. The first step is the decrease in the number of facets and corresponding lenses and retina; after a few generations—perhaps in four or five—the facets become reduced to only four or five; the eye is then useless; then all at once, perhaps after only two or three generations, as a result of disuse, there is a failure in forming images on the retina, and those complicated, elaborate structures, the optic ganglion and optic nerve, suddenly break down and are absorbed, though the external eye still exists in a rudimentary state. These imperfect lenses and retinæ, like all rudimentary organs throughout the animal world, are like ancient, decayed sign-posts, pointing out some nearly obliterated path now unworn and disused. The result of change of environment, with disuse and atrophy of the organs of vision, together with the inheritance of these defects and their establishment as fixed specific and even generic characters, results in the creation of a new natural genus with its assemblage of species, and, if we include all the cave animals thus produced, the creation of a new fauna. It would be a thorough test of the theory of descent if we could keep these creatures in confinement, exposed first to twilight and then to the full light of day, and endeavor to breed a few generations of these blind animals and ascertain whether their descendants would not revert to the original ancestral eyed forms. The *Cœcidotœa* would perhaps be the best subject for such an experiment; it is so abundant and easy to breed. That the *Cœcidotœa* has been evolved

from some species of *Asellus* hardly admits of a doubt. Our *Asellus communis* abounds under sticks and stones, submerged boards and logs, throughout the Northern and central States. Thence it could readily be carried, in cavernous regions like those of southern Illinois, Indiana, and Kentucky, into subterranean streams. The supply must be very great, as the individuals of *C. stygia* are very abundant; indeed, so far as we know, as much as or even more so than those of *Asellus communis*.

In the blind crayfish of the caverns of Indiana and Kentucky, and of the similar species (*C. hamulatus*) inhabiting the Nickajack Cave of Tennessee, we have two aberrant forms belonging to a widely diffused group, whose center of distribution lies in the Mississippi Valley, and which is rich in species and in individuals. All the streams and ditches situated over or near the caves are densely populated with crayfish. I was interested, after finding *C. pellucidus* in a stream flowing through the Bradford Cave, near New Albany, Indiana, to find the common eyed crayfish of that region in great abundance a few yards from the mouth, outside of the cave, in the shallow brook issuing from the cave itself. That crayfish with eyes can readily enter a cave—probably in time of freshets—is proved by the fact that *Cambarus Bartonii* is often found in Mammoth Cave, where it finds food; and a small specimen has been found by Mr. Putnam a little paler than usual—i. e., as pale as the darker specimens of *C. pellucidus*—but the eyes were normal, though it is doubtful if it lives long enough in the cave to breed there.

The nearest out-of-door ally of *Cambarus pellucidus* is *Cambarus affinis*. On the other hand, the nearest lucicolous ally of *C. hamulatus* is perhaps *C. latimanus*.

It is instructive to find that, in regard to the development of the eyes, and the slenderness, size, and color of the body, these two cave crayfish closely resemble each other, though obviously originating, as Prof. Faxon states, from species belonging to quite different sections of the genus *Cambarus*, and to a different, more southern, river valley. These facts appear to prove beyond question that the cave species of crayfish in the United States have descended from quite different species of *Cambarus*, belonging to different zoögeographical areas. Had the two species of blind crayfish been produced instantaneously by special creation, as popularly supposed and advocated in the past by some naturalists, why should the accessory genital organs (*gonopoda*) differ so much that on this account they belong to different sections of the genus *Cambarus*?

The cave *Phalangidæ*, or harvest-men, whose habits and distribution in Europe as well as the United States, both as regards lucicolous and cavernicolous forms, have been given in much de-

tail elsewhere, illustrate clearly the theory that certain subterranean forms, living deep in the soil, under stones in the cave regions of both hemispheres, especially in France and Austria, have been carried into caves, have survived the loss of out-of-door conditions, becoming adapted to the new and strange environment, losing their eyes totally or in part from disuse of those organs, and have bred true to the new specific characters thus established, and are now as unchangeable as the physical conditions in which they live.

The cave spiders in all important respects exemplify the same rule. They belong to, or are closely allied to, genera rich in species in the cavernous regions they inhabit, and which live in dark places. Although scarcely necessary in its changed environment, where there are no hydrographic changes, no winter and summer, and few enemies to contend with, the most aberrant form, the completely eyeless *Anthrobia* of Mammoth Cave, still spins a silk cocoon around its eggs; while in Weyer's Cave *Nesticus pellidus* Emerton spins a cocoon for its eggs; and either this species or its fellow troglodyte, *Linyphia incerta* Emerton, or both species, spin a weak, irregular web, consisting of a few threads. Is not this a useless habit, a simple survival of ancestral traits?

It was noticed that the number of individuals of different species was greater in the smaller shallower caves, such as the Weyer and Carter Caverns; each of these groups of caves has three species, while in Mammoth Cave there is but one, and the individuals are less common. Moreover, all are darker than *Anthrobia*, all have eyes, and the number of eyes is variable. These facts show that *Anthrobia* and the eyed forms have originated from species living in partial darkness at or near the mouths of the caverns. In Mr. Emerton's description of *Linyphia incerta* it will be seen how variable are the number of eyes. From this it may be inferred that the specific characters of this form, as regards the eyes at least, have not been firmly established, and hence it has only recently become a true troglodyte.

In the foregoing examples we have as yet not discovered in this country any connecting links between the eyed and blind or eyeless species of cave animals. But in a series of specimens of a cave myriapod, *Pseudotremia cavernarum*, which is abundant in the Wyandotte and Carter Caves, we have what we regard as good, if not complete, evidence that this cave form has directly originated from a common and widely distributed out-of-door form. The cave *Pseudotremia* has black eyes, composed of from twelve to fifteen facets arranged in a triangular area; of one hundred and fifty specimens examined none were found to be eyeless. In a large cave like Wyandotte there is little variation in this species as regards size, proportion, or color (being white with a

slight flesh tint). But in Bradford Cave, a grotto in Indiana, only three hundred to four hundred yards deep, where the conditions are naturally more variable, the species likewise varied more in proportion of parts, and in respect to the eyes, which were more rudimentary, while the individuals were whiter.

We have attempted to show that the only known species of the myriapod genus *Pseudotremia* has been derived from the widely diffused *Lysiopetalum lactarium* (Say); it differs in having only about half as many segments as in its out-of-door parent form (this diminution in the number of segments being due to arrest of development); in the smaller, rudimentary eyes, while the antennæ are slenderer and longer. Now, in the Carter Caves of eastern Kentucky we found specimens which prove to us that the cave form is only a modified *L. lactarium*. In those caves *Pseudotremia cavernarum* is only partly bleached, being brownish; the eyes are larger, having from twenty-three to twenty-five facets; and the general appearance of the specimens is such, especially the prominent ridges on the latero-dorsal tubercles, that the specimens might be mistaken for pale, partly bleached *L. lactarium*; yet the variety (*Carterensis*) is true to its generic character, having half as many segments as in *Lysiopetalum*. Why the number of body segments should be so greatly diminished in the cave form is only explicable on the ground that it is due to an arrest of development, or that the cave form has descended from some unknown species of *Lysiopetalum*, with half the number of segments as *L. lactarium*.

In like manner the Mammoth Cave hairy myriapod, *Scoterpes Copei*, was evidently derived from some species of the hairy genus *Trichopetalum*. *Scoterpes* has no trace of eyes, and differs from *Trichopetalum* in the longer legs and slightly longer and slenderer antennæ. There is no reasonable doubt but that *Scoterpes* is a bleached *Trichopetalum* which has lost its eyes, and consequently has longer legs. Some systematists may yet refer it to *Trichopetalum*, to which it has the same relations as *Anophthalmus* to *Trechus*. It should be observed that several myriapods found in twilight within the mouths of caves, such as species of *Polydesmus* and *Cambala*, are more or less bleached, showing the change wrought by a life in partial darkness after a limited number of generations.

The *Podurans* afford instances of the modification of color especially. Whether living in caves in the central States or in Utah, the common cosmopolitan *Tomocerus plumbeus* is bleached, retaining its eyes, though they are of diminished size. This is, however, rather a twilight than a true cave species.

The beetles of the genera *Anophthalmus* and *Adelops* are the best-known examples of cave animals. The *Adelops* of Mammoth

Cave and a few adjoining caves—the only species in this country of the genus—is blind, but possesses rudiments of the outer eye, several corneal lenses surviving. On the other hand, the species of this or the closely allied representative genus *Bathyscia*, to which they are now referred by Dr. Horn, are very numerous in Europe, and are scavengers in habit. Bedel, in his list of the cave insects of Europe (1875), states that sixty-five species are known, and that several others were known but not described, and that probably further explorations in the region of the Pyrenees, both in France and Spain, will lead to further discovery of species. It appears that not all the species live in caves, but occur in the open air under large stones, moss, vegetable detritus, or at the entrances to caves. It is apparent, then, that the cave animals are emigrants from out of doors, and that the cave species, by isolation from the light and from interbreeding with out-of-door forms, as well as by adaptation to total darkness, have become fixed species with separate generic characters.

Equally instructive and explanatory of the origin of cave animals in general is the genus *Anophthalmus*. In the caverns of the central United States there are only eight species, and none occur elsewhere in America, though we have two or three species of *Trechus*, one at least not infrequent, and *Trechus micans* is common to both hemispheres. Not alone loss of sight and eyes, but other modifications of the body, legs, and antennæ, evidently the result of loss of sight, occur, so universal is the modification of the organism. It is evident that southern Europe is the zoögeographical center of this subgenus, for sixty-four species of completely eyeless beetles referred to this genus have already been discovered in the caves of Austria, Italy, France, and Spain. Lately, however, owing to the studies of Putzeys, and especially of De Perrin, the genus *Anophthalmus* has been united to *Trechus*, since there is a series of forms with more or less rudimentary eyes connected with the eyed species of *Trechus*. Bedel also tells us that in all the species of *Trechus* there is a natural tendency to penetrate into grottoes, even when ordinarily they live in the open air buried in the earth under stones.

It seems reasonable to conclude that the cave species, which are without optic ganglia, optic nerves, and any traces of eyes, had originally, by adaptation to total darkness, become isolated, and that their characteristics after being fixed by heredity have been transmitted for generations, becoming as unchanging in their way as the physical conditions of darkness and uniform temperature surrounding them. Those living in the open air in the soil under stones, or at or just within the entrances to caves, vary most as regards the eyes, as we have found to be the case with the other forms previously mentioned.

This intimate dependence on the physical conditions of life is so plainly shown in these animals, that we can well understand how potent have been the factors (i. e., change from light to total darkness and an even cave temperature) which have operated on out-of-door forms to induce variation. Given great changes in the physical surroundings, inducing loss of eyes from disuse, the abolition in some cases of the optic ganglia and optic nerves, the elongation of the appendages, isolation from out-of-door allies, and the transmission by heredity owing to close in-and-in breeding within the narrow fixed limits of the cave, and are not these collectively *veræ causæ;* do they not fully account for the original variations and their fixation; in short, can we not clearly understand the mode of origin of cave species and genera? What room is there in a case like this or in that of parasitic animals for the operation of natural selection? The latter principle only plays, it has seemed to us, a very subordinate and final part in the set of causes inducing the origin of these forms.

THE CHINESE THEORY OF EVOLUTION.

By ADELE M. FIELDE.

NOT long ago I engaged a new Chinese teacher, Mr. Khu, and as I was his first foreign acquaintance, as he had never tampered with books of Western origin, and as he was said to have made a special study of the occult sciences and to be devoutly religious, I considered him a treasure-trove. That which I here set down as the Chinese theory of evolution has been translated largely from Mr. Khu's expositions of cosmogony. It agrees with what I have gathered, through conversations in the vernacular, from other native scholars.

Neither Lau-Tse, Confucius, nor Buddha, the founders of the three great religions whose tenets harmoniously dwell together in the Chinese mind, has set forth an account of the making of the universe. But the human intellect seems to trend inevitably toward attempts to explain the existence of things seen, and so there is a Chinese theory of evolution, whose exact origin it is difficult to trace through the four millenniums and the myriads of volumes that hold the written history of the empire.

In the beginning all matter was transparent, diffused, and without differentiation. In it dwelt the dual powers; both subtle, ethereal, and eternal; but the one was virile, warm, radiant, and active; the other, feminine, cold, somber, and quiescent. These dual powers are symbolized by two similar, conjoined figures, whose outlines may be made by drawing upon the diameter of a

circle two oppositely directed semicircles, whose centers are those of the two radii. The reciprocal action of the dual powers, continuing through ages, produced all that is. Puan Ko, sometimes represented as a giant holding up the sun and moon and shaping the mountains, is only the personification of the forces that wrought in chaos.

A zenith, a nadir, and all the points of the compass were gradually evolved. There came to be a distinction between the bright heavens, with the seven moving luminaries, and the dark earth, with its seas. The male principle predominated above, the female principle predominated below, as Father Heaven and Mother Earth, each having an all-pervading spirit, but with unlike influence. The body comes from and depends upon the earth; the soul comes from and returns to the heavens.

The rocks are the bones of the divine body, the soil is the flesh, the metals are the nerves and veins; the tide, wind, rain, clouds, frost, and dew are all caused by its respirations, pulsations, and exhalations. Originally the mountains rose to the firmament, and the seas covered the mountains to their tops. At that time there was, in the divine body, no life besides the divine life. Then the waters subsided; small herbs grew, and in the lapse of cycles developed into shrubs and trees. As the body of man, unwashed for years, breeds vermin, so the mountains, unlaved by the seas, bred worms and insects, greater creatures developing out of lesser. Beetles in the course of ages became tortoises, earth-worms became serpents, high-flying insects became birds, some of the turtle-doves became pheasants, egrets became cranes, and wild cats became tigers. The praying mantis was by degrees transformed into an ape, and some of the apes became hairless. A hairless ape made a fire by striking crystal upon a rock, and, with the spark struck out, igniting the dry grass. With the fire they cooked food, and by eating warm victuals they grew large, strong, and knowing, and were changed into men. There is a story that the ape who first taught cooking had a peculiar origin. He was imprisoned, from the beginning, in a rock on the sea-shore. The waves beat on the rock century after century, and at last wore away all except the ape that had been its center. Then the sun warmed him, and the winds breathed upon him, till he became alive, and with a divine impulsion went and taught his kind to cook their food.

Khu says: "In the early days of man there were peace and plenty, because no one disturbed or maltreated the body of God. Those who saw a stone removed from its natural site, wept, and

carried it back and put it in the place from which it came. Children were taught that if they found a piece of metal they must not touch it. No silver, nor gold, nor jade was to be seen in any dwelling. To the wise, dreams were given, in which the universal parent spoke, saying: 'Child, the gold, the jade, the metals, and the gems are all parts of my body. Touch them not, nor meddle with them to my hurt and yours. To take stones from the earth is to dislocate the bones of one's parent; when the parent suffers, the dependent child is harmed.' In those days the soil was red and rich; it was heavy as iron, and so ductile that it could be drawn into filaments. There was no need of fertilizing the fields. Whatever was planted grew quickly, and the kernels of grain were as large as chestnuts, and the potato-tubers were as large as squashes now are. The products of the earth were so nutritious that one meal a day was sufficient, and so luscious were they that condiments were needless. It is the disrespect shown to the divine body that has made the life of man so hard. One should be content with what may be had without deeply disturbing the soil. The displeasure of Heaven is often manifestly visited upon the agriculturists who give the land no rest, and the lightning frequently strikes those who are at work in the fields. Those who walk on mountains soon tire, because they tread upon the bones, while those who keep to the artificial highways are not so soon fatigued."

This pantheistic theory being in its loftiest conceptions too abstract for the masses, it is expressed by them in the assertion that "there is a god to every eight feet of space." Every tree, grotto, and hummock has its tutelary deity. Consequently, no man begins to dig a cistern, to remove earth from a hill, to cut a stone, or to till a garden, without offering propitiatory gifts to the local divinity. If fever, headache, or dyspepsia follow the effort, the displeasure of the god is believed to be its cause, and the work is apt to be abandoned.

It is at once apparent that this pantheistic theory of evolution offers serious hindrance to the utilization of the metals contained in the mountains, to the opening of mines, the building of railroads, and the erection of structures requiring deep foundations. It has prevented the Chinese from availing themselves of the vast mineral resources of their country, from leveling thoroughfares where they are pressingly required for traffic, and from full use of the products of the earth in promoting the well-being of man. It is the chief reason why the emigration of hundreds of thousands of men in search of work has now become necessary. If the Chinese were unhampered by fear of the invisible ones who are considered by all to be the real proprietors of the land, they would have an abundance of lucrative work within their own

borders, and they need not then afflict other countries by their immigration. The losses that accrue to them through this false theory are both positive and negative. It occasions an enormous outlay upon profitless offerings that must be bought with money earned by hard labor; and it prevents their use of the wealth stored in their lands. Affecting daily the welfare of hundreds of millions of persons, it well illustrates the practical evil of false doctrine, and, by contrast, shows the great economic value of truth.

SKETCH OF ALEXANDER WILSON.

A PECULIAR interest attaches to the lives and labors of pioneers. The circumstances which led to the discovery of a new continent, the first application of one of the forces of nature to the service of man, the making of the first instrument for viewing the stars, and the first description of the animals, plants, or physical features of a country, always have eager readers. Then, too, the personality of a man who has the courage and originality to set forth into an untrodden field is generally picturesque and inspiring. All these claims to attention are possessed by the pioneer American ornithologist.

ALEXANDER WILSON was born on the 6th of July, 1766, at Paisley, in Renfrewshire, which lies just south of the river Clyde. His father, Alexander Wilson, was a weaver, and reached the age of eighty-eight years, dying in 1816. During the latter part of his life, at any rate, the father was rated as a most exemplary citizen, but there is a glamour of "moonshine" about his early manhood, in the sense that, when not occupied with tending the loom, he operated a "wee still," from which trickled good Scotch whisky that was consumed without paying tribute to the tax-collector. This has naturally been denied, but not with entire success. His wife was a Mary McNab, of a strictly pious character, and with the beauty that frequently accompanies a tendency to consumption. Of this disease she died when young Alexander, who was one of three children, was ten years old.

Like many devout Scottish folk, the parents of "Alic," especially his mother, cherished the ambition that their boy should "wag his head i' the puppit yet," but his genius did not lie in the direction of the ministerial office. He attended the Grammar School of Paisley, but his schooling must have been interrupted and of no great amount, for much of his boyhood was otherwise occupied, and his deficiencies in grammar, spelling, etc., clung to him till manhood. He is known to have struggled with his backwardness in arithmetic after emigrating to America. His hand-

writing was called excellent, and his language was simple and idiomatic. The taste for reading, which he early developed, largely made up for his scanty schooling. At one time he was sent to be a herd on a farm called Bakerfield, not far from Paisley, where he remained probably not more than a single summer. It is said that "he was a very careless herd, letting the kye transgress on the corn, being very often busied with some book."

In his thirteenth year he was bound apprentice as a weaver, for three years, to his brother-in-law, William Duncan. Having served out his time in 1782, he continued a weaver "by constraint, not willingly," for four years, living part of the time under his father's roof in Paisley and in Lochwinnoch, and finally with his brother-in-law at Queensferry. His taste was for outdoor life, and he had inherited a feeble constitution from his mother, so that the loom was irksome to him both mentally and physically. During this period young Wilson began to contribute verses to the local newspapers. His best piece, however, "Watty and Meg," was published in 1792, as a penny chap-book, without his name, and was ascribed to Robert Burns. The latter, who lived not far away, and was but six years older, strengthened the compliment by avowing that he should have been glad to be its author. Wilson's descriptive pieces are interesting, from the evidence they give of his natural fondness for the woods and fields.

After a while Duncan decided to "travel" as a peddler through the eastern districts of Scotland, and invited Alexander to accompany him. Accordingly, the two abandoned the loom and entered upon their new occupation. The Scotch peddler of that time was generally a man of shrewdness and common sense, probably resembling the best type of our own departed Yankee peddler, and was generally respected by the common people, but often suspected and despised by the wealthier. This occupation, although it delivered Wilson from the confinement of the weaving-room, was not all sunshine. It involved trials and rebuffs, which to a man, as Grosart * calls him, "of sensitive, strangely refined if also in elements as strangely coarsened temperament," must have been hardly borne. His "Journal as a Pedlar," several poems bearing on his experiences of the road, and his earlier letters, give a realizing sense of the lights and shadows of this kind of life. In addition to his trading, he solicited subscriptions for a volume of poems, which he published in 1790.

In a short time he dropped the pack and returned to his hated trade of weaving. Being in ill-health and sorely oppressed by poverty, he was at this period much given to despondency. Yet he

* "The Poems and Literary Prose of Alexander Wilson," edited, with Memorial Introduction, Essay, etc., by the Rev. Alexander B. Grosart, two vols., Paisley, 1876.

had a humor which enabled him at times to joke about his necessities. He had a gift of satire, also, which got him into some trouble, but which was the cause of his taking the first step in the path that led to fame. Industrial affairs in Great Britain at that time were greatly unsettled. Many of the Paisley weavers were unemployed, and capital and labor were arrayed against each other. Some of the turbulent spirits among his fellow weavers induced the enthusiastic young Wilson to use his talent for verse-making to abuse the capitalists. Several poems of his, portraying in no flattering light certain local petty tyrants, were adjudged libelous, and Wilson, who manfully acknowledged their authorship, was fined heavily, and condemned to burn the poems in public. Being unable to pay the fine, he was sent to jail.

In this hour of gloom, Wilson's eyes were turned to the New World. Attracted by the chances for winning his way open to a free man in a new country, he determined to emigrate. Accordingly, he and his nephew, William Duncan, sailed from Belfast Loch, Friday, May 23, 1794, and after a voyage of over seven weeks landed at Newcastle, Delaware. Wilson was then twenty-eight years old. He and young Duncan went first to Wilmington, and from there to Philadelphia, looking for employment at weaving. At the latter place, he writes in his first letter home to his father and step-mother, "we made a more vigorous search than ever for weavers, and found, to our astonishment, that, though the city contains between forty and fifty thousand people, there is not twenty weavers among the whole, and these had no conveniences for journeymen, nor seemed to wish for any: so, after we had spent every farthing we had, and saw no hopes of anything being done that way, we took the first offer of employment we could find, and have continued so since." This employment was in the shop of a copper-plate printer. The above quoted letter was a long and very newsy one, and contains Wilson's first observation of the feathered creatures that were to make his fame. He writes: "As we passed through the woods on our way to Philadelphia, I did not observe one bird such as those in Scotland, but all much richer in color. We saw a great number of squirrels, snakes about a yard long, and some red birds, several of which I shot for our curiosity."

Wilson remained in his first found employment but a few weeks. After that he worked at his trade of weaving at a place ten miles north of Philadelphia, and for a short time in Virginia. In 1795 he tramped through northern New Jersey as a peddler. He had been in America but little over a year when he took up school-teaching, and at this occupation he succeeded remarkably well, although it gave him only a scanty income. He first opened a school at Frankford, but soon gave it up to become master of the school at Milestown, in Philadelphia County, where he taught for

nearly six years. His own education had been limited; so, after he began to teach, he had to study diligently to make up his deficiencies. He advanced so far in mathematics that he was enabled to take occasional employment as a surveyor.

After leaving Milestown he taught for a while at Bloomfield, N. J., but he found this place disagreeable, and he was at the same time burdened with a trouble, only dimly revealed in his letters, but in which one of the Milestown young ladies figured. He became very despondent, and even thought of returning to Scotland. It was not long before he obtained a school at Kingsessing, near Gray's Ferry, on the Schuylkill. His removal to this place was attended with important results. He became acquainted with William Bartram, whose famous garden was not far away, and with Alexander Lawson, the engraver, both of whom became his steadfast friends. Bartram lent him books, among them, the works of Catesby and Edwards. In the parts of these works relating to American birds, Wilson's own acquaintance with the birds was enough to show him an exasperating number of errors, false theories, and caricatured figures. During the early part of his life at this place Wilson was so despondent that Lawson at one time feared for his reason, and advised him to give up poetry and his flute, which seemed to increase his melancholy, and to take up drawing. This accomplishment does not seem to have come very naturally to him, for he made a failure of the landscapes and human figures which Lawson set before him. Still, the statement of an American writer, that he was "without any previously suspected aptitude," is denied by Mr. Grosart, who adds that drawings by him before he left Scotland are preserved in the Paisley Museum with the collection of Wilson's manuscripts. Bartram and his niece, Miss Nancy, started him again on easier subjects, first flowers, and then birds, with which he made encouraging success.

It is in a letter to one of his Scottish biographers, his old friend in Paisley, Mr. Thomas Crichton, under date of June 1, 1803, that Wilson's determination to study the birds of America is earliest recorded. "Close application to the duties of my profession," he writes, "which I have followed since November, 1795, has deeply injured my constitution, the more so that my rambling disposition was the worst calculated of any one's in the world for the austere regularity of a teacher's life. I have had many pursuits since I left Scotland—mathematics, the German language, music, drawing, etc., and I am now about to make a collection of all our finest birds." At first he devoted only leisure hours to the birds, and his figures "were chiefly colored by candle-light," but he soon began to make longer and longer expeditions. In October, 1804, he set out with two companions, on foot, to visit Niagara. From there he went through the lake region of central New York, visit-

ing his sister and her children, who were living on a farm that Wilson and his nephew William had bought together. He made his way home down the Mohawk Valley to Albany, and thence by boat to New York. In this journey, occupying two months, he traversed over twelve hundred miles. Winter overtook him in the midst of it, so that the latter part of it was made "through deep snows and almost uninhabited forests; over stupendous mountains and down dangerous rivers." The trip seems to have benefited both his health and spirits, for in his account of it, written to Bartram, he expresses eagerness for wider explorations and new discoveries. "With no family to enchain my affections, no ties but those of friendship, and the most ardent love of my adopted country; with a constitution which hardens amid fatigues, and a disposition sociable and open, which can find itself at home by an Indian fire in the depth of the woods, as well as in the best apartment of the civilized [world], I have at present a real design of becoming a traveler. But I am miserably deficient in many acquirements absolutely necessary for such a character. Botany, mineralogy, and drawing I most ardently wish to be instructed in, and with these I should fear nothing." How oblivious to matters of detail his enthusiasm made him can be judged, Ord* remarks, from the fact that at this time Wilson's available cash amounted to *seventy-five cents.*

Two of the birds which he shot in New York, one being the Canada jay, were unknown to Wilson's associates. He made careful drawings of them, and got Mr. Bartram to send them to President Jefferson, whom Wilson much admired. The President, who was quite an amateur naturalist, replied with a very appreciative letter, in which he put Wilson on the track of a certain sweet-singing and very unapproachable bird. He had "followed it for miles without ever, but once, getting a good view of it," and had for twenty years tried to get a specimen without success. "After many inquiries and unwearied research," says Ord, "it turned out that this invisible musician was no other than the wood robin, a bird which, if sought for in those places which it affects, may be seen every hour of the day." The next summer Wilson announced to Bartram his determination to make a collection of drawings of the birds of Pennsylvania, and sent him twenty-eight for criticism. The scope of his undertaking was extended, within a few months, so as to include the whole United States. He had planned an expedition down the Ohio and Mississippi Rivers for the summer of 1806 with Bartram; but the latter, who was nearly seventy years old, gave up the idea. Wilson, who had heard that explorers were to be sent up the Red and Arkansas Rivers,

* "Life of Alexander Wilson," by George Ord. In Volume IX of the "American Ornithology."

through the recently acquired Territory of Louisiana, then offered himself to President Jefferson for this service. "Mr. Wilson," says Ord, "was particularly anxious to accompany Pike, who commenced his journey from the cantonment on the Missouri, for the sources of the Arkansas, etc., on the 15th of July, 1806." But no reply was made to his application.

In April he was engaged by the publishers, Messrs. Bradford and Inskeep, as assistant editor for the revision of Rees's "New Cyclopædia," on "a generous salary," namely, nine hundred dollars a year. He now gave up school-keeping, which had been his calling for ten years. While in this position, he made known his plans for the "American Ornithology" to Bradford, who readily agreed to undertake its publication. A prospectus was immediately issued, and a year later, in September, 1808, the first volume of the work appeared. In the fall of that year he made a trip through New England, "in search of birds and subscribers." On the way from Philadelphia he stopped at Princeton, to show his work to the college professors. He expected to get some valuable information on American birds from the Professor of Natural History, "but," he writes, "I soon found, to my astonishment, that he scarcely knew a *sparrow* from a *woodpecker*." Wherever he showed his book to college professors, and other literary men, the highest praise was lavished upon it, but subscriptions were not so freely forthcoming, the price, one hundred and twenty dollars, being a serious obstacle. He wrote from Albany, on his way home, that he had obtained only forty-one subscribers. One of the less intelligent personages, whose favor he had sought, was the then Governor of New York—Daniel D. Tompkins. This magnate, as Wilson informs us, "turned over a few pages, looked at a picture or two, asked me my price, and, while in the act of closing the book, added, 'I would not give a hundred dollars for all the birds you intend to describe, even had I them alive.'"

He soon set off again on a trip through Baltimore, Washington (where he was received "very kindly" by Jefferson), and other Southern cities, and when he reached home had in all two hundred and fifty subscribers. In the South he shot several new birds. It was now deemed advisable to add three hundred impressions of Volume I to the two hundred first struck off, and the second volume started with an edition of five hundred copies. His undertaking had already won him "reputation and respect," but the pecuniary return was still doubtful.

Volume II of the "Ornithology" was ready in 1810, and in February of that year Wilson set out on another hunt for new specimens of the feathered tribes and those rare birds—subscribers. His varied adventures on these expeditions, and his impres-

sions of the people and places that he visited, are delightfully recorded in the letters which Mr. Grosart collected.

At Hanover, Pa., he met a judge who condemned his work because "it was not within the reach of the commonality, and therefore inconsistent with our republican institutions." Wilson turned the tables on this learned man by showing that the judge's elegant three-story brick house was open to the same objection; and then in a more serious vein pointed out to him the benefit which a young, rising nation can derive from science, "till he began to show such symptoms of intellect as to seem ashamed of what he said." From Pittsburg Wilson made his way in a skiff down the Ohio over seven hundred miles, nearly to Louisville, stopping at the important towns on the way.

At Louisville one of the persons on whom he called was Audubon, then thirty years old and engaged in business. Audubon has left an account of this meeting, in which he thus describes Wilson's physical appearance: "How well do I remember him as he walked up to me! His long, rather hooked nose, the keenness of his eyes, and his prominent cheek-bones, stamped his countenance with a peculiar character. . . . His stature was not above the middle size." Audubon claims that he was about to subscribe for the "Ornithology," but a complimentary reference to his own knowledge of birds, spoken in French by his partner, checked him. "Vanity and the encomium of my friend prevented me from subscribing," he writes, and to this he adds that he lent some of his drawings to Wilson, and hunted with him, obtaining some birds which the latter had never seen before. Audubon states also that being in Philadelphia some time afterward he called on Wilson, who received him with civility, but did not speak of birds or drawings. Against this story must be set the following extract from Wilson's diary published in the ninth volume of the "Ornithology": "March 23d, I bade adieu to Louisville, to which place I had four letters of recommendation, and was taught to expect much of everything there; but neither received one act of civility from those to whom I was recommended, one subscriber, nor one new bird; though I delivered my letters, ransacked the woods repeatedly, and visited all the characters likely to subscribe. Science or literature has not one friend in this place." "We must take Audubon's account," says his own biographer, Robert Buchanan, "*cum grano salis*," while Grosart, eager in defense of Wilson, does not hesitate to call it "a tissue of lies," except his admission that vanity kept him from subscribing to Wilson's work.

Turning southward, Wilson crossed Kentucky to Tennessee, and proceeded through the Chickasaw and Choctaw countries to Natchez, and thence went to New Orleans.

By persistent labor the successive volumes of the "Ornithology" were issued up to the seventh, which appeared in the spring of 1813. On the 6th of July in that year he wrote: "I am myself far from being in good health. Intense application to study has hurt me much. My eighth volume is now in the press and will be published in November. One volume more will complete the whole." But he was not to see the appearance of even the eighth volume. The unremitting labor of that summer, carried on in the city, where even his tramps with his gun were cut off, so reduced his strength that he succumbed to an attack of his old enemy the dysentery and died, August 23, 1813, at the age of forty-seven. The immediate cause of the attack was his swimming a river in pursuit of a rare bird that he caught sight of while visiting a friend. Wilson died unmarried, although in his letters he condemns celibacy, and shows that he was not indifferent to female companionship. In fact, he was to have married a Miss Miller, whom he made one of his executors. George Ord, who had accompanied Wilson on some of his trips, was made a co-executor, and completed the publication of the "Ornithology," prefixing to the last volume a life of the author. The original edition of Wilson's great work is now rare. It comprises nine thin folio volumes, about eleven by fourteen inches in size. Several birds are figured on each plate—the smallest ones of life-size, the others reduced. An edition in three volumes, including the birds afterward described by Prince Bonaparte, was issued in 1829–'36,* and another in four volumes, edited by Prof. Robert Jameson, in 1831.

Wilson was no compiler; he took his facts from his own observations, or the accounts of those who had known the birds for a lifetime. He had, further, as Grosart says, a "magnetical sympathy with the birds whereby his descriptions of their looks and ways and faculties take the coloring of so many little biographies of personal friends."

Sir William Jardine says of Wilson: "He was the first who truly studied the birds of North America in their natural abodes, and from real observations; and his work will ever remain an ever-to-be-admired testimony of enthusiasm and perseverance—one certainly unrivaled in descriptions; and if some plates and illustrations may vie with it in finer workmanship or pictorial splendor, few, indeed, can rival it in fidelity and truth of delineation."

* "American Ornithology," by Alexander Wilson and Prince Charles Lucien Bonaparte. Edited, with a Life of Wilson, by Sir William Jardine, Bart.

CORRESPONDENCE.

FARMING AND THE TARIFF.

Editor Popular Science Monthly:

DEAR SIR: The article in your November issue, by Joel Benton, on "The Decadence of Farming," greatly interested me, as it must every lover of our country, and it suggested several questions which I believe should be considered, that we may get at the facts.

The reasoning is that, because farming has decayed at the same time that a protective tariff has prevailed, which has enhanced, as it is claimed, the cost of what the farmer has had to buy, therefore the tariff is responsible for this decay. Saying nothing of the claim that the tariff does in the long time enhance the price of what the farmer has to buy, let us ask how free trade has helped the farmers in Great Britain. Is it not a fact that during these same years farming has decayed there fully as much as in our own country? The wonder is how, with produce so low, the Irish farmers can pay their rent, and many can not, and the land-owners' profits have almost disappeared. A Yorkshireman recently told the writer that he knew of many large farms the owners of which would be glad to give a lease for a term of years *for no rent*, if the land could be kept up. Now, by parity of reasoning, may we not say that, seeing farming has decayed in Great Britain, at the same time that free trade has prevailed, which has brought down the price of what the farmer has to buy, therefore free trade has caused the decay of farming? Is it any better in free-trade Holland, from which the farm laborers are coming to the writer's own community, because the best farm laborer there can get but forty cents a day, whereas here he gets at once more than double? Do not these facts suggest the question whether there are not other causes besides tariff or free trade which may account for this manifest decay of farming?

Has not the wonderful cheapening of transportation brought cheaper and, for a time, more fertile soils into competition with the dearer and worn-out soil of our older States? Cereals and meat and wool can be raised so cheaply on these new lands that the Western farmer, with the low cost of transportation added, can undersell the farmers of the older States. The same is true in the case of Great Britain. And this power to undersell is increased by the use of machinery in farming, which use can be so much greater and more effectual on the large farms of the new States than in the older States. A bushel of wheat or corn can be raised with a small part of the labor cost in Kansas or Dakota as compared with New York. The result is, that in the older States the farmer is compelled to look for his profits to raising the products that will not bear transportation, either because they are perishable, as milk, or because they are too bulky, as hay. He must depend upon the near-by market, and supply it with what the farmers of the West can not send it.

Does not this suggest another thought? We must look for relief, not in the direction of urging more to engage in farming, but by finding, if possible, other employments for men which are more profitable; and this, many of us still believe, can be done better with a wisely adjusted protective tariff than with free trade, which would tend to crowd still more the already overfull ranks of the farmers. JOHN R. THURSTON.

WHITINSVILLE, MASS., *October* 30, 1889.

A REMONSTRANCE.

Editor Popular Science Monthly:

SIR: I have been accustomed to read with a high degree of pleasure the contributions of Mr. Grant Allen which I have seen from time to time in your pages. Reading in your December number his "Plain Words on the Woman Question," copied from the "Fortnightly Review," I rubbed my eyes once or twice over the following words, which seem, after a second or third perusal, much *too* plain:

"Whether we have wives or not—and that is a minor point about which I, for one, am supremely unprejudiced—we must at least have mothers."

Calving must go on, no doubt, if the race of horned cattle is to be kept up, and it is not important that calves should know their own fathers, or have an acknowledged parentage on the male side. It is quite otherwise with human beings, and I submit that no teacher of biology can afford to be without a bias in favor of wives, looking strictly at human progress, which is the great desideratum of the article in which this extraordinary passage occurs.

Possibly the words quoted may have a biological meaning somewhat different from the obvious meaning. If so, Mr. Grant Allen should be cautioned, when writing for the laity, to use the kind of language which they understand. If the obvious meaning is the real meaning, I have only to say to him, "Never more be officer of mine." H. W.

NEW YORK, *November* 30, 1889.

Mr. Allen, we are sure, is the very last man who would deliberately say anything calculated to encourage immoral tendencies.

There is, however, in this particular controversy, much excuse for the plain speaking to which our correspondent takes exception. The real woman question, which, as Mr. Allen points out, is whether woman shall unsex herself or not, has long been obscured by a sort of sentimental glamour which is daily exerting the worst kind of influence in society; and when the scientific man takes up the subject, it becomes his duty, if he would be true to the spirit of his craft, to set forth in the strongest light the essential facts of the case. All through his article it is the biological question involved which Mr. Allen keeps to the front, and in the passage complained of he, as we read him, is simply emphasizing the supreme importance of this aspect of the subject.—EDITOR.

ENVIRONMENT AND THE REPRODUCTIVE POWER OF ANIMALS.

Editor Popular Science Monthly:

I HAVE read with great interest an article in the November number of "The Popular Science Monthly" entitled "Conditions affecting the Reproductive Power of Animals," and, while I fully agree with the facts as stated, it seems to me that the manner in which it is written savors overmuch of the "carpenter theory of creation."

I do not deny that "the activity of the reproductive function is in proportion to the unfavorableness of the embryonic environment"; but is not this a fact rather than a law? It is true that the power of producing young in immense numbers is the *conditio sine qua non* among lower orders of animals, but should we not look deeper for the reason of this power? Are there any laws in nature which exist simply because they are good?

Among the lower orders of animals the weight of each offspring is much less in proportion to that of the parent than among the higher. The organization of the lower orders being much simpler than the higher, the offspring can be brought to perfection in a much shorter time. Therefore, each individual offspring of the lower orders is produced with much less expenditure, on the part of the parent, of both matter and vitality. Were these the only differences, they would be sufficient to account for a vast difference in reproductive power.

This reproductive power is fostered by natural selection. Among those species whose young are exposed to so many chances of destruction, those varieties which possess the greatest reproductive power are more likely to survive in the struggle for existence, and will transmit to their offspring their more vigorous reproductive power. To say that the reproductive power of an animal can be affected directly by anything which may happen to the offspring after birth reminds us of the belief current among children that, if a lost tooth be swallowed by a dog, a dog's tooth will grow in its place.

We know that the existence of a species in any given state depends upon certain conditions. While the study of that species may teach us much concerning those conditions, it is necessary for us to take a wider and deeper view before we can discover the causes which led to them; and we should ever keep in mind the fact that while the species owes its existence, in any given state, to those conditions, the conditions were not necessarily created by Nature for the sake of preserving the species in that particular state. Nature helps those, and only those, who help themselves.

CHARLES A. PEPLE.

RICHMOND, VA., *November* 4, 1889.

A CORRECTION.

Editor Popular Science Monthly:

DEAR SIR: My attention has been called to a slip occurring in my article in the April issue of the "Monthly." In the sentence (in the foot-note, page 727) reading ". . . Add to this the confession of an exposed medium, Mr. D. D. Home," etc., the exposed medium is not D. D. Home, but one cited by him as exposed. The only hint I have as to the origin of the printed version is from my fragmentary notes for the paper, in which the words stand thus: "Add to this the confession of an exposed medium (D. D. Home, 'Lights and Shadows of Spiritualism,' etc.)." I remember deciding to omit all mention of names wherever possible, and must have crossed off part of the parentheses instead of all. I am very sorry that so slight an error should have ended in throwing blame where it did not belong, and especially so as my point was simply that *a* medium was exposed in the manner indicated, it being entirely immaterial who the medium might be.

I must further apologize for the lateness of my writing, on the plea of a six months' absence abroad, and the consequent accumulation of duties awaiting me on my return.

Truly yours,

JOSEPH JASTROW.

MADISON, WIS., *Oct.* 31, 1889.

EDITOR'S TABLE.

TOLSTOI'S "CONFESSION."

AMONG the numerous writings from the pen of Count Tolstoi which have of late been made accessible to the English reader is one entitled "My Confession." In this work the author tells us that, having in his youth led the life of a pleasure-loving man of the world, and in his maturer years of a literary man in considerable repute, he woke up in middle life, when all his outward circumstances were highly prosperous, to find that life to him seemed to possess no meaning and no value. He could find no answer to the Carlylean questions "Whence?" and "Whither?" and so distressed was he thereat that for a long time he was haunted by the thought of suicide. He had recourse to science, and could get no light; to philosophy, and could reap no consolation. It seemed to him as if some tyrant had called him into existence simply to make a mock of him, by hiding from his eyes the answer to life's riddle—by implanting in him an instinctive love of life, and yet depriving him of the knowledge which alone would supply a rational motive for living.

The nature of Tolstoi's trouble is fully explained in his book. His youth had been one of passion and riot, unguided by any principle save the loose code of honor prevalent in military circles. As an author he had encountered men with whom literature was a means for the gratification of vanity and nothing more, whose aims were sordid, whose ideas were conventional, and whose lives were actually worse than those of the wild companions of his youth. Yet these men set themselves up for guides of society and final arbiters in all questions of taste and morals. Tolstoi himself had caught their tone, and for a time imagined that, because he enjoyed popularity as a writer, he must necessarily be a very superior person. According to the ideas prevalent among his literary friends, the world existed for hardly any other purpose than to provide them with the opportunity for airing their superiority. It is not surprising that a man of Tolstoi's sensibility should eventually have been led to see the falsity of this whole view of life; the only wonder is that he did not revolt against it sooner than he did. The thoughts that came to him toward middle life have come to some others much earlier. The poet Clough was only twenty-two when he wrote:

> "How often sit I poring o'er
> My strange distorted youth,
> Seeking in vain, in all my store,
> One feeling based on truth;
> Amid the maze of petty life
> A clew whereby to move,
> A spot whereon in toil and strife
> To dare to rest and love!"

The life of Tolstoi had been essentially based upon privilege. He had lived above the mass of mankind, and had imbibed the narrow ideas of an exclusive set. He had not taken humanity into his thoughts, except for purposes of literary treatment; and, therefore, when a period of calm reflection came, though his intellectual pride took flight, and his false ideas stood confessed in their falsity, what to do he knew not. It seemed to him that he had to construct a new philosophy of life, and in the search for a solid basis for such a philosophy he endured the distress which he has so vividly described. He attacked the problem, however, from the wrong side, asking questions which only metaphysicians or theologians have ever attempted to answer, and which have never been answered in any satis-

factory manner. After many wanderings and many perilous lingerings on the very verge of despair, he bethought himself of the thousands and millions of human beings who go about their daily tasks and take up their daily burdens without repining or misgiving, who find a natural sweetness in life, and never think of worrying themselves over questions of ontology or metaphysics. These, he said to himself, must possess the true secret of life, and the best thing I can do is to learn it of them.

Tolstoi was here getting upon solid ground. His previous life had been governed without any reference to cardinal principles of duty or to the essential relations of human beings to one another. One of the aphorisms of the founder of the Positive Philosophy is that between individual man and the universe humanity is needed as mediator. Suppress humanity, that is to say, suppress all true thoughts in regard to humanity, suppress the sense of inclusion in and identification with the great human whole, and individual man is indeed a poor, defenseless thing, or, as Matthew Arnold has expressed it—

"A naked, eternally restless mind."

No words could describe better than these the true condition of the great Russian's mind when the scales had fallen from his eyes, and he realized in what a vain show he had been walking. Peace came to him through his suddenly awakening to a sense of the vastness of the life of humanity, and his sudden resolve to take refuge in it, and, as far as possible, to make its thoughts and feeling his own. The lesson in all this is obvious, and it is in direct line with our remarks in a previous number under the head of "The Domain of Science." There is a science of life. There is a way of regarding our relations to the world at large which is true; and, unfortunately, there are many ways of regarding them which are false. There are thoughts, tempers, dispositions, habits, that make for soundness both of mind and body, and there are others in great variety that make for unsoundness. There are certain normal conditions of existence determined by the whole course of human evolution; and these can not be too widely departed from, under the guidance of purely individual feelings, without serious danger. The work of placing life on a sound basis may be begun at any time, though early is indeed much better than late. It is all a question of seeing things in their right relations and acting accordingly—all a question of extending the domain of science from biology and physiology to sociology and individual conduct. Rightly read, Tolstoi's "Confession," though it mentions science but disparagingly, should be a great help in this direction. It certainly contains a grave warning against the tyranny of the passions and the utter hollowness of much that passes for literature and philosophy.

THE LAND QUESTION.

It is almost needless to direct attention to the letters on the land question published in this issue, as the names of certain of the writers would alone create interest in the discussion. Mr. Spencer, unfortunately, has been for some time in a state of health that almost wholly incapacitates him for the labor of the pen; and, though he has given us two very interesting letters, most readers will feel that he has hardly done full justice to his own position. He has confined himself to the criticisms of Prof. Huxley, and passed unnoticed those of Mr. Greenwood and Sir Louis Mallet. Had he possessed his old-time fire and energy, he would probably have dealt with all his critics in a manner that would have left little to be desired; we may be sure at least that he would have considered fully and fairly all their objections to his views, and would have given any necessary explanations in that spirit of candor which has always distinguished him.

It will be noticed that Mr. John Laidler, "bricklayer," is disposed to be severe upon Mr. Spencer for having in part abandoned the views expressed by him as long ago as the year 1852, in his work on "Social Statics." It is hardly worth while, however, to be a philosopher if a man can not mature and, if necessary, modify his views as he advances in life and gathers the fruits of experience and reflection. Mr. Spencer long ago recognized that in his "Social Statics" he had expressed himself somewhat unguardedly on the land question; and he has refrained for many years from giving any currency to his earlier opinions on that subject. Had his health permitted, it is not improbable that he would have taken some recent occasion for reviewing the whole question, and giving the world the benefit of his latest thought. As it is, he is obliged to content himself with indicating the germ of truth in his former views, and the modifications and safeguards he would now attach to the enunciation of the general principle which they embodied.

Mr. Frederick Greenwood, who participates in the discussion, undertakes to point a serious moral, to the effect, namely, that philosophers should be careful how they scatter abroad ideas which may serve as the seeds of revolution. The caution reminds us of a famous one given by St. Peter to St. Paul, some of whose writings, the former apostle thought, "the unlearned and the unstable" might "wrest to their own destruction." It was St. Paul, however, with his bent toward philosophy, who moved the ancient world to embrace Christianity. What his critic did in that direction is not very conspicuously recorded on the page of history. Mr. Spencer has labored hard to rationalize the thought of his age, to bring the minds of men into contact with the laws that — whether we recognize them or not—govern human life; and if, by some, his teachings are misunderstood and misapplied, we must judge of his total influence, not by such cases, but by the whole volume of mental activity that owes its origin to his writings.

The general impression which the controversy will leave on the minds of most readers will be, if we mistake not, that the land question is a good one to leave alone—at present. Not that there are not many abuses connected with the tenure of land waiting to be corrected; but that the correction of such abuses can best be accomplished without raising the fundamental question as to whether land can or can not be held by as good a title as chattel property. In this country, a few years ago, we had a slight wave of excitement in connection with the theories propounded in Mr. George's "Progress and Poverty"; but the conviction has been strengthening, we believe, in most thoughtful minds that, plausibly and eloquently and earnestly as Mr. George has presented his ideas, their adoption could only lead to social and political confusion. The world at large will be better when men individually are better; and social justice will reign when individual justice reigns. The land requires to be appropriated to and by individuals in order that the best and most profitable use may be made of it; but it does not follow that the individual occupier should act the part of a tyrant toward his fellow-men. A man may do that without owning a foot of land. Every man who follows a gainful trade or profession has an interest in the land, seeing that those who own and till it, own and till it for him to the extent of the demand expressed by his wages or emoluments. The world wants justice and wants it now; but it would be a poor inauguration of justice to turn title-deeds to which society has given every possible sort of sanction into waste paper, and virtually confiscate the honest earnings, invested in land, of millions of honest men.

THE TWENTIETH BIRTHDAY OF "NATURE."

"NATURE," now accepted as the foremost scientific journal in Europe, signalizes the beginning of its forty-first volume by reviewing its own career and the advancement of science during the twenty years that have elapsed since its first number was issued, in November, 1869. It came forward without obtrusive advertising, and without making any promises other than what was implied in the statement in Prof. Huxley's introductory article that its aim would be "to mirror the progress of that fashioning of herself in the mind of man which we call the progress of science." It now claims, with a justice that all its readers will recognize, that it "has not disappointed the hopes of its founders, nor failed in the task it undertook." Its pages fairly reflect the aspects which scientific discussion has assumed from year to year; and every established conclusion has been suitably noticed in them as it gained the right to claim attention. The reader can turn to its columns for facts bearing on all matters of interest of this kind, in the assurance that he will find them there. "Nature" has been able to accomplish this purpose, it says, by enlisting the co-operation—in contributions, and by advice and suggestion—of the leaders in all branches of research, and by showing its desire to be for the good of science and the promotion of knowledge—regarding these as of more importance than journalistic success. While its most prominent function has been to present at first hand the results of the work of these men, it has not disregarded the laity of science. Besides taking pains to present its professional articles in a form acceptable to the great body of unlearned inquirers, it has in its correspondence department given them a free parliament for discussion. Making itself a faithful mirror of scientific thought, it speedily gained favor among English readers; extended its reputation abroad; and became the one journal indispensable to students in every branch and every land.

Its record of the achievements of science during its lifetime, though consisting only of the briefest mentions, is a large one, and includes such facts as the establishment of the Darwinian theory, the periodic law in chemistry, the determination of a relation between electricity and light, the progress of bacteriological investigation, the advance of spectroscopical discovery, the vast expansion of physiological research, and many other matters of hardly inferior moment. In all these achievements English investigators are exhibited as among the most active, solid in work, and thorough in inquiry; and none have been more sagacious than they in generalization and in applying principles to practice. Not the least important of the results is the education of a generation who have sufficient knowledge of science to recognize its importance and give it its true position; so that, when now it points out a new field of inquiry or asserts a new principle, it has no longer apologetically to face suspicion and hostility, but meets a friendly and helping public.

LITERARY NOTICES.

RECENT ECONOMIC CHANGES AND THEIR EFFECT UPON THE PRODUCTION AND THE DISTRIBUTION OF WEALTH, AND THE WELL-BEING OF SOCIETY. By DAVID A. WELLS, LL. D., D. C. L. New York: D. Appleton & Co. Pp. 493. Price, $2.

Two years ago Mr. Wells contributed to "The Popular Science Monthly" a series of articles entitled "Recent Economic Disturbances." They elicited so much comment and discussion that the author now presents them as a book. In so doing he has brought his record of fact down to date, and extended his review so as not merely to treat the economic derangements which date from 1873–'74, but to include the economic history of the past three decades.

In comparing the present earnings of labor and assets of capital with the figures for 1860, Mr. Wells shows that the economic

advance of the last thirty years has been little short of revolutionary. Science applied to field and farm, mill and factory, ship and railroad, has enormously increased the efficiency of labor. Hence the remarkable rise in wages, and the correlative fact of the fall of prices which makes a dollar exchangeable for more food and clothing than ever. Although the fortunes of men have been steadily improving, heightened sensibility, progress in social ambition, all that goes to raise the standard of living, have kept pace with the increase of popular luxury and refinement. Then, too, the blessings of industrial evolution, though general, have not been universal; and in considering its incidental pains and penalties Mr. Wells is both candid and sympathetic. He notes how handicraft skill is rendered valueless as machinery supersedes trade after trade. Old-time shoemakers now only get cobbling to do, and the tinsmith who once made all the paraphernalia of the kitchen is to-day no more than a tinker. Minute subdivision of labor reduces an operative to a mere tooth on a wheel; disrupted from it by an untoward accident of trade, he is of little more worth than a bit of scrap-metal. In manufactures and commerce modern exigencies demand a discipline which almost completely effaces individuality: both employers and workmen are subordinated as parts of a vast and complex enginery. In undergoing the painful and costly readjustments enforced by new economies, capital and labor have been partners in distress, and labor has not suffered more than capital. The increase in the average man's wealth has been partly at the expense of certain unfortunate classes of capitalists. While one set of farmers are being enriched by the rise in the value of Dakota lands, another set in France and England are being impoverished by the cheapness of Dakota wheat. The Suez Canal, in shortening the route between Europe and the East, effected a saving in freights greatly to the advantage of consumers of tea, silk, cotton, and spices: it also threw into idleness a vast fleet of ships adapted to the voyage around the Cape of Good Hope, and ruined a lengthy chain of interests vested in things as they were. The discovery of excellent coal and iron-ore near together in Alabama cheapens iron, but it extinguishes furnaces in the Northern States built at enormous outlay, and leads to the abandonment of large foundry properties in New York and New England. Every new machine and process, while it enriches the community, entails loss on individuals for expensive plant which must go to the scrap-heap.

While Fortune in the economic world has in the main been prodigal of her gifts, those upon whom her lash has fallen very naturally demean themselves differently from those upon whom she has smiled. While the cultivation of inconspicuousness on the part of millionaires is far from uncommon, those who have seen their possessions melt away in the discarding of old machinery, old methods, and old routes, make loud complaint. Of equal loudness is the alarm vented by those who have reason to fear loss through the supersedure of their property as Science marches on. This complaint and this alarm have been so sustained as to create an exaggerated impression of the evils economic progress brings in its train. Left to themselves, economic forces would merge the world into a single competitive field, the markets of which would be supplied only from the sources where capital and labor could work to most advantage. The redistribution of populations and employments which this would entail is a price a majority of civilized nations refuse to pay: its incidental loss and misery impress their imagination too deeply. Yet the choice is between this shunned evil and a greater. Vastly more is lost by declining to enjoy the gifts new knowledge stands ready to confer, in declining the harvests labor can reap when free to sow and till where natural conditions most favor it. Nothing in Mr. Wells's book is more impressive than the picture he draws of European nations severally striving by force of law to overcome some defect in soil, climate, position, or skill. France, for example, excludes American wheat as far as she can by a high duty. Does she not thereby injure the population of bread-eaters more than she eases the lot of a few wheat-growers? The vanity of attempts to juggle with inexorable Nature has imperiled interests higher than those of wealth; these attempts have checked the good-will which was springing up as trade united international interests and foreigners were ceasing

to be strangers. In making battle-fields of their custom-houses, ethnic dislike has, doubtless, served to stimulate commercial jealousy among the people of Europe, and this in its turn fans the animosities which endanger peace.

While their neighbors have been indulging in costly tariff reprisals upon each other, the British, Dutch, and Swiss, firmly holding to freedom as the right rule of trade, have, perhaps unconsciously, borne testimony to economy and ethics being fundamentally one. Theirs has been the chief progress not only in wealth, but education, the abatement of crime, the lengthening of life. Russia, at the other extreme of fiscal policy, aiming at nothing short of the prohibition of foreign trade, finds her markets depressed and her treasury depleted. The oblique form of protection known as the bounty system has been tried with results which, as traced by Mr. Wells, must have surprised the experimentalists. France and Germany, in artificially stimulating the production of beet-root sugar, have only succeeded in taxing themselves heavily to provide their chief rival in manufactures, Great Britain, with an important raw material at less than cost. The British industry in jam and sweets, expanded by cheap sugar, now employs more people than those needed to refine the sugar consumed.

The general fall in prices during the recent past has been a source of much embarrassment and perplexity in the world of commerce. Among the theories proffered in its explanation that of the bimetallists has been prominent, and Mr. Wells riddles it thoroughly. He shows that whereas the cost in labor of producing gold has varied but little for ages, silver during this generation has been discovered in prodigious deposits; therefore any legislative attempt to maintain a hard-and-fast relation between the values of gold and silver must be vain. He points out that the gold reserves in the banks of the world are to-day, proportionately to capital, larger than ever. Furthermore, that the demand for gold constantly diminishes as banking facilities overspread the world with their telegraphic transfers, clearing-houses, and other devices for the economy of coin. But if it be demurred, Does not a debt incurred, say, ten years ago, require to-day more wheat or iron for its satisfaction than the sum could have bought when first borrowed? Certainly, but the wheat or iron represents no more labor now than it did ten years ago, and its increase in quantity stands for the new efficiency which applied science has bestowed on toil. Let the fall in the rate of interest be noted as evidence that, among sufferers from reduced pay, capital ranks as chief.

In every page, whether considering the eight-hour movement, the transportation problem, the gigantic cost of protecting American iron and steel for a decade, or any other of the manifold lines of his inquiry, Mr. Wells's analysis is transparent and impartial. In tracing the bearing of economic development on the welfare of man he rises by breadth of mind and sympathy to the dignity of a philosopher.

A Popular Treatise on the Winds. By William Ferrel, Ph. D., late Professor and Assistant in the Signal Service. New York: John Wiley & Sons. Pp. 505. Price, $4.

Several essays bearing upon the mechanics of the atmosphere have been published by Prof. Ferrel at various times since 1856, but, as they were of a very mathematical character, they were adapted only to those well-trained in mathematics. The present volume is of a more popular nature, although the simpler mathematical operations involved in the presentation of the subject are retained. After a general description of the constitution and nature of the atmosphere, the effect of the earth's rotation in the dynamics of the atmosphere is explained, the general circulation of the atmosphere is described, and its climatic influences are pointed out. This circulation is shown to agree with the laws governing the movements of gases and vapors acted upon by heat and other forces. The rest of the volume is devoted to descriptions of the various kinds of winds, monsoons, land and sea breezes, cyclones of several varieties, and tornadoes, and explanations of their special causes. Thunder-storms water-spouts, hail-storms, and cloud-bursts, with various other allied phenomena, are also explained. The author offers his book to general readers interested in the subject, and to lecturers on meteorological subjects before college classes or other audiences.

EUROPEAN SCHOOLS. By L. R. KLEMM, Ph. D. International Education Series, Vol. XII. New York: D. Appleton & Co. Pp. 419. Price, $2.

RARELY has a book for teachers appeared containing so much that can be used in the school-room. It is not a ponderous and repulsive budget of statistics of school attendance, examination marks, illiteracy, etc., with courses of study and descriptions of departmental machinery. It is an account of the notable features observed during a trip of nearly a year among the educational institutions of the continent of Europe, or, as the author describes it in his sub-title, "what I saw in the schools of Germany, France, Austria, and Switzerland." The first device described in the book is an expedient which was employed by a teacher in Hamburg, and is called by the author "a master stroke." A stupid boy could not see that the difference between plus six and minus ten is sixteen. The master explained the problem and illustrated it with marbles, but in vain. Finally, he cast his eyes about the room, and they fell upon the thermometer. In a moment he had this before the pupil's eyes, and readily made him comprehend that the difference between 6° above zero and 10° below zero is 16°. A box of movable letters, a board with a slit in it through which letters making words are shown, a scheme for ventilation, a mode of teaching home geography, and a sketch of an efficient city school system, follow within the compass of a few pages. Methods of teaching drawing in different schools are described in several parts of the volume, and singing, knowledge of nature, mensuration, and language are only a few of the subjects dealt with. A notable section is that devoted to "a separate school for dullards," an idea which started in Rhenish Prussia at Elberfeld and has spread to other cities. This is not a school for idiots, but is intended for those unfortunate children whose dullness acts as a drag on their classes and brings ridicule and discouragement upon themselves. Here they receive patient instruction, and learn much more than they could in schools adapted to brighter pupils, while the latter are freed from impediments to their progress. The account of girls' industrial education at Cologne, comprising knitting, crocheting, embroidery, weaving, sewing, lace-making, cutting out garments, mending and patching, and accompanied by drawing, will be found interesting and suggestive. It is impossible to mention here all the subjects touched upon in this book; they cover a wide range, and each is presented in sufficient detail to give a definite idea of the method employed. The style of the book is clear and enthusiastic; the language is simple and, in humorous passages, even colloquial. It is a very readable volume—one which the teacher can take up at odd moments even when tired, and study without a sense of laboring. A notable feature of it is its abundance of illustrations, there being five hundred and twenty-three figures showing drawing models and outlines, articles used in teaching, plans of school-buildings, maps made in teaching local geography, articles and patterns made in manual training schools, etc., etc.

THE JOURNAL OF PHYSIOLOGY. Vol. X. Edited by MICHAEL FOSTER, M. D., F. R. S. Cambridge (Eng.): Cambridge Scientific Instrument Company. Pp. 576. Thirty-three Plates. Price, $5 a volume.

THERE are two papers in this volume on "The Regulation of Respiration," by Henry Head. The first details experiments made to ascertain the effects on breathing produced by dividing the *vagi*, by altering the volume of the lungs, by artificial respiration, and other means. Many observations were also made on the forms which the apnœa pause produced by artificial respiration assumes under various conditions. Nine plates of curve tracings accompany this paper. The theoretical conclusions from these experiments are embodied in the second paper. C. A. MacMunn contributes an account of experiments from which he infers that "bilirubin and biliverdin are produced in the liver mainly from effete hæmoglobin; these are acted on in the small intestine by the digestive and putrefactive ferments, and some, at least, changed into simple metabolites like the urobilin-like substance of bile." Stercobilin, formed in the intestines from derivatives of bile and hæmatin, may be taken up and excreted in the urine as pathological urobilin. Some "Observations on Human Bile obtained from a Case of Biliary Fistula," by S. M. Copeman and W. B. Win-

ston, appear in another number of this volume. Regarding "The Nature of Kneejerk," W. P. Lombard maintains that the reflex theory readily explains the intimate dependence of the phenomenon upon the spinal cord, and that the time argument against it is inconclusive, owing to our meager knowledge of reflex times in general, while the peripheral theory is untenable. The third number of this volume is devoted to a paper on "The Relation between the Structure, Function, Distribution, and Origin of the Cranial Nerves; together with a Theory of the Origin of the Nervous System of Vertebrata," by W. H. Gaskell. It is accompanied by five plates. W. D. Halliburton contributes the results of chemical analysis of a number of specimens of cerebro-spinal fluid, and, together with W. M. Friend, the results of an examination of the stromata of the red corpuscles. A second paper on "The Electrical Organ of the Skate," by J. B. Sanderson and Francis Gotch, contains observations as to the nature of the normal reflex process by which the electric organ is discharged, and the measurement of the electromotive force of the response of the organ to a single excitation. J. N. Langley reports further investigations upon the salivary glands in two papers, one dealing with "The Physiology of the Salivary Secretion," the other with "The Histology of the Mucous Salivary Glands, and the Behavior of their Mucous Constituents." L. C. Woolbridge, in a brief paper entitled "The Coagulation Question," argues against certain views of Dr. Halliburton. W. H. White contributes "Further Observations on the Histology and Function of the Mammalian Sympathetic Ganglia," a previous paper having been published in No. 2, Vol. VIII of the "Journal." An extended paper on "The Innervation of the Renal Blood-Vessels," by J. Rose Bradford, deals with the courses of the vaso-constrictor and vaso-dilator fibers, with the phenomena following excitation of the splanchnic nerve and of the peripheral end of the divided vagus, also with the reflex phenomena of the renal vessels. T. W. Shore and H. L. Jones publish a description of "The Structure of the Vertebrate Liver," approaching their subject from the side of comparative anatomy. G. N. Stewart presents a detailed account of a research on "The Stimulation Effects in a Polarized Nerve during and after the Flow of the Polarizing Current." C. S. Sherrington and C. A. Ballance, in a paper on "Formation of Scar-Tissue," give the record of their investigation as to whether the colorless corpuscles of the blood are the source of the new tissue which the inflammatory process produces.

HYGIENE AND PUBLIC HEALTH. By LOUIS C. PARKES, M. D. Philadelphia: P. Blakiston, Son & Co. Pp. 471. Price, $2.50.

SUBSTANTIALLY the whole field of sanitary science is brought within a moderate compass in this book. Water, removal of refuse, ventilation, warming, lighting, climate, building-sites, food, exercise, and clothing, all receive due attention from the hygienic side. A chapter on the prevention of communicable diseases has been included, also one on vital statistics. The book is intended for both the physician and the layman. Its language is simple enough, so that no technical knowledge is needed to understand it, though there are some tests and calculations included which the average layman will not make use of for himself. Numerous examples and illustrations are introduced in order to assist the physician in his public health work. The author deems the chapter on the removal of refuse rather long in proportion to the book, but gives as his reason for going so much into detail that apparently trivial defects in house-drainage, which are liable to be overlooked without thorough knowledge, are often the cause of the most severe outbreaks of disease. The volume is lettered on the back, "Practical Hygiene, Parkes," but the intending buyer should not confuse the book with the "Manual of Practical Hygiene" by the late E. A. Parkes.

A FIRST BOOK IN AMERICAN HISTORY. By EDWARD EGGLESTON. Illustrated. New York: D. Appleton & Co. Pp. 203. Price, 70 cents.

THE story of America is told by Mr. Eggleston in this book in a simple and vivid style. The requirements that he has had in view while preparing it are that an elementary book must, for those whose school-life will be short, give the leading facts of the whole field to be studied, and must not force upon those who are to follow it with an advanced work matters which will have to be restudied

later. Furthermore, a beginners' book ought, before all things else, to be interesting. "The main peculiarity of the present book," says the author, "is that it aims to teach children the history of the country by making them acquainted with some of the most illustrious actors in it. A child is interested, above all, in persons. Biography is for him the natural door into history. The order of events in a nation's life is somewhat above the reach of younger pupils, but the course of a human life and the personal achievements of an individual are intelligible and delightful." By this means, also, the young American gets distinct pictures of the careers of the great men of his country. It is easy, moreover, in a history of the biographical type, to adopt the modern style of describing the life of the people in former times, as well as the progress of public events. The author is convinced that the lamented lack of moral teaching in our schools can be largely supplied by the inspiring examples found in the careers of our great men. The author has availed himself abundantly of the aid of pictures in giving the pupil a vivid conception of the narrative. No precise mode of studying the book is prescribed, but brief suggestions for a topical recitation are appended to each lesson. The book is well adapted to be used as a class reader, and several school superintendents have already declared their intention of employing it in this way. The pictures are numerous and bear the signatures of some of the most eminent illustrators in America. The maps are bird's-eye views, and one, designed to show the territorial growth of the United States, has the successive additions of territory printed on successive pages, the blank parts of which are to be cut out.

CHEMISTRY: GENERAL, MEDICAL, AND PHARMACEUTICAL. By JOHN ATTFIELD, F. R. S., etc. Twelfth edition. Philadelphia: Lea Brothers & Co. Pp. 770. Price, $3.25.

THIS substantial volume is adapted to be the life-long companion of the pharmacist or physician—a manual of instruction in his student days and a work of reference in his business or professional practice. The author expressly disclaims the recognition of any such varieties of the science as medical and pharmaceutical chemistry, and uses these terms only to indicate that he illustrates the principles of chemistry by those facts of special interest to the followers of medicine and pharmacy. "From other chemical textbooks," he states in the preface, "it differs in three particulars: first, in the exclusion of matter relating to compounds which at present are only of interest to the scientific chemist; secondly, in containing more or less of the chemistry of every substance recognized officially or in general practice as a remedial agent; thirdly, in the paragraphs being so cast that the volume may be used as a guide in studying the science experimentally. The order of subjects is that which, in the author's opinion, best meets the requirements of medical and pharmaceutical students in Great Britain, Ireland, America, India, and the English colonies." A few leading properties of the elements are first given, some of the fundamental principles of the science are next stated, and then the properties and relations of the elements and the compound radicals are presented in detail, attention being directed to those qualities on which analysis and synthesis depend. The chemistry of the carbon compounds is next considered. Practical toxicology and the chemistry of morbid physiological products then receive attention. The concluding sections form a laboratory guide to the chemical and physical study of quantitative analysis. In the appendix is a long table of tests for impurities in medicinal preparations; also a short one of the saturating powers of acids and alkalies, designed for use in prescribing and dispensing. In his arrangement of the radicals, the author "has preferred to lead up to, rather than follow, scientific classification," for the reason that systems of classification give "undue prominence to one set of relations and undeserved obscurity to others." The metric system is alone used in the sections on quantitative analysis; in other parts of the volume avoirdupois weights and imperial measures are employed. Numerous etymological notes are scattered through the book. A list of questions follows each section. The present edition contains what alterations and additions have become necessary since the appearance of the eleventh in 1885. The work now includes the whole of the chemistry of the United States Pharmacopœia and nearly all that of the British and

Indian Pharmacopœias. The chief new feature is the extended section on organic chemistry. By means of the index of fifty-six pages all the information in this comprehensive volume is made readily accessible; eighty-eight cuts show the forms of apparatus needed for the operations described.

STRENGTH: HOW TO GET STRONG AND KEEP STRONG By RICHARD A. PROCTOR. London and New York: Longmans, Green & Co. Pp 178. Price, 75 cents.

THE scope of this book is well set forth in the following sentences from the introductory pages: "Men, and women too, though they may have no occasion to acquire skill in athletic exercises, have great occasion to possess sound bodies, unless they are passing absolutely useless lives, when they may do as they please so far as their value to the community is concerned. . . . I propose in this little treatise to show how, by devoting a few hours weekly to well-arranged exercises, this end can be attained. No violent exertions are necessary, no difficult feats need be attempted, no special form of exercise need occupy much of the time and attention." Successive chapters are devoted to the description of exercises, many without apparatus, the others with only simple appliances, adapted to the expansion of the chest, and to the development of the muscles of the chest, abdomen, loins, arms, and legs. There are also chapters on reducing fat, the adapting of exercise to advancing years and to weakness, some "notes on rowing," and directions for learning to swim. A comparison of "Nature's Waist and Fashion's" is included, to which a lady contributes her experience in discarding the corset and adopting the divided skirt. The volume is illustrated with figures of classic statuary and of gymnastic apparatus.

THE STORY OF THE BACTERIA. By T. MITCHELL PRUDDEN, A. M. New York: G. P. Putnam's Sons. Pp. 143. Price, 75 cents.

EVERYBODY has heard of bacteria; many with a conscientious desire to keep informed upon the progress of science have undertaken to read up about them; and a large proportion of these inquirers must have retreated baffled from the task. But if those who have been discouraged by the technicalities of the learned treatises on micro-organisms would still like to know what the bacteria are and do, and how they are cultivated and examined, they can find out very pleasantly by reading Dr. Prudden's simple and fascinating "Story of the Bacteria." The author describes the chief forms of bacteria, and several kinds which are curious from their color, power of emitting light, etc. He then tells how they act in producing surgical diseases, consumption, and typhoid fever, and what means are taken to repel their attacks. He also sets forth what is believed in regard to the relations of bacteria to Asiatic cholera, diphtheria, pneumonia, scarlet fever, etc.—diseases in which the action of the germs is less easily demonstrable. He points out, further, how impure food, air, water, and even ice may serve as sources of bacterial infection; and in conclusion gives the layman an intelligent view of the present standing of investigation in this field. This little book shows how perfectly a scientific subject may be freed from perplexing technicalities, and may well serve as a model of popular scientific writing.

According to the *Report of the Commissioner of Fish and Fisheries for 1886* (United States Fish Commission), the work of the year included explorations along the eastern coast of North America from the Straits of Florida to Newfoundland, in order to ascertain the winter range and habits of the mackerel, menhaden, blue-fish, and other important food fishes that resort to the eastern shores of the United States in the warmer months. Observations of the temperatures and densities of the water were made continuously at all the stations of the Commission, from the Commission's vessels, and at many light-houses and light-ships. The schooner Grampus, intended as a model for off-shore fishing smacks, and also containing a well for the conveyance of live fishes, was completed and added to the fleet of the Commission in this year. The distribution of the eggs and fry of food fishes was continued. The papers appended to the report comprise a comprehensive account of "The Sea Fisheries of Eastern North America," by the late commissioner, Spencer F. Baird; "A Review of the Flounders and Soles of America and Europe," by

David Starr Jordan and David Kop Goss; a review of the *Sciænidæ*, by Prof. Jordan and Carl H. Eigenmann; a paper on internal parasites of fishes, by Edwin Linton; and a report on *Medusæ*, by J. Walter Fewkes, all but the first of these being illustrated. A large number of reports from the vessels and stations of the Commission are printed, and the following papers from foreign sources are included in the volume: "On the Fish-cultural Establishments of Central Europe," by E. Bettoni and D. Vinciguerra; "Chemical Composition of Food Products," by P. Kostytscheff; "Cases of Poisoning caused by Spoiled Codfish," by Dr. E. Mauriac, and "Notes on the Norwegian Fisheries of 1885," by A. N. Kiaer. There is also a list of stations at which dredgings have been made in the Atlantic and Arctic Oceans from 1867 to 1887, by Sanderson Smith. The list is accompanied by five charts.

A translation of a series of essays by the Baroness *Marenholtz-Buelow*, setting forth Froebel's educational system, has been published under the title *The Child and Child-Nature* (Bardeen, $1.50). It describes the nature of the child, his needs, and the effects of training upon him. An account of Froebel's method is given, and this is followed by some of the exercises and translations of the songs which he devised for teaching the child's relations to nature, to mankind, and to God. A bibliography of Froebel is appended, and an index has been added to the American edition.

Dr. *R. von Krafft-Ebing's Experimental Study in the Domain of Hypnotism* has been translated into English by Charles G. Chaddock, M. D. (Putnam, $1.25). It is an account of a case which has excited much interest in Grätz, and comprises the preliminary history of the patient, a record of the course of her hystero-epileptic attacks, and a transcript from Prof. Krafft's daily note-book of hypnotic experiments upon her.

Evolution of the Electric Incandescent Lamp, by *F. L. Pope* (H. Cook, Elizabeth, N. J.), is a collection of extracts from records of courts and of the Patent-Office, newspaper files, and transactions of scientific societies bearing upon the question whether Edison or Sawyer and Man deserve the credit for the employing of a carbonized filament of organic material in the incandescent lamp. The book is illustrated with cuts of apparatus.

A beginner's text-book of *Iron and Steel Manufacture* has been prepared by *Arthur H. Hiorns* (Macmillan, $1), designed to give a knowledge of the principles underlying the processes of this industry. In the early chapters the substances used or produced in smelting are defined, the ores of iron are described, and the chemistry of the subject is explained. Then follow descriptions of the usual methods of extracting and refining the metal, and of the furnaces, hammers, and rolls employed in these operations. Iron casting, tinning, and galvanizing are also described. The processes in the production, tempering, and testing of steel are set forth in like manner. Questions are appended to each chapter for the use of students.

No. 96 of Van Nostrand's Science Series is on *Alternate-Current Machinery*, and comprises a paper read by *Gisbert Kapp* before the Institution of Civil Engineers, London, with the discussion upon it. Of the apparatus which may be properly included under his title, the author deals especially with alternators, transformers, and motors. The volume is illustrated with forty-three diagrams.

Since the first edition of the *Manual of Assaying Gold, Silver, Copper, and Lead Ores*, prepared by *Walter Lee Brown* (E. H. Sargent & Co., $2.50), was noticed in this magazine, the book has been increased from 318 to 487 pages. Other changes as given by the author are, "the stating of all charges in assay tons, grammes, and grains; detailed charges in the scorification process; full notes on the colors and appearances of the scorifiers (with a colored plate) and cupels after work; the expansion of the crucible process from *nine* to almost *ninety* pages; more complete articles on the assay of gold and silver bullion, and the volumetric analysis of copper ores; and, finally, the issuance of the book in flexible covers." The present (third) edition is but little changed from the second.

The little book by the late *Walter Bagehot*, embodying a *Plan for Assimilating the English and American Money*, first published in 1869, has been reissued in view of an expected revival of interest in the

subject (Longmans, 75 cents). The author names, as trifling advantages of an international coinage, the convenience of travelers, facility in the exchange and transmission of coin, and in the comparison of monetary statistics. What he deems the one great advantage of such a money would consist in making identical the monetary language of the trade circulars of different nations. He believes that an international coinage should be founded on a single standard, have a high *gold unit*, have decimal divisions, and do no violence to national jealousies. Several international unit coins have been proposed—a twenty-five-franc piece, the English sovereign, a piece weighing ten grammes, and a ten-franc piece—but Mr. Bagehot points out objections to them all. The scheme which the author proposes is to unite the two great Anglo-Saxon nations upon a system of coins, by changing the sovereign from 960 to 1,000 farthings, or £1 0*s.* 10*d.*, which is almost identical with the American half-eagle. He believes that Germany and the Latin Union would in time adopt the Anglo-American money.

In his essay on *Involuntary Idleness*, read before the American Economic Association, and now published as a book (Lippincott, $1), the author, Mr. *Hugo Bilgram*, searches for the cause of lack of employment. He first examines the relation of capital and interest to labor, and obtains the inference that "a close relation exists between the economic cause of involuntary idleness and the law of interest." The author states that there is a tendency for the industrial class to drift into bankruptcy, and for money to accumulate in the hands of the financial class, thus depriving the channels of commerce of the needed medium of exchange, and causing stagnation of business and dearth of employment. The law of interest is then evolved by an analysis of the monetary circulation between the debtors and creditors. From this analysis is drawn the inference that "an expansion of the volume of money, by extending the issue of credit-money, will prevent business stagnation and involuntary idleness."

The Teacher's Manual of Geography, by *Jacques W. Redway* (Heath, 55 cents), consists of suggestions to teachers on out-of-door lessons for young pupils, the use of pictures and models, recitation, map-making, geodesy, hydrography, meteorology, history in geography, and boundary lines. Simple ideas of form, size, color, and locality are suggested to be presented to the youngest children in preliminary oral work. The tendency of the book throughout is to lead the teacher to give pupils a practical, comprehensible knowledge of the earth's surface, to correct popular errors, and to escape from traditional ruts. A list of books for geographical reading is appended.

A series of *Topics in Geography*, prepared by *W. F. Nichols*, for the use of his own schools, has now been published (Heath, 55 cents). The author states that his aim has been to make the study of geography more valuable, while shortening the time usually spent upon it. To this end he shows what to teach and what to omit, giving first a brief outline for a study of any continent based upon slope, and furnishing topics, to be taken up after this, which cover all that it is desirable to learn. Other features of his treatment are the sparing use of statistics, the combination of language with geography, and the making prominent of natural objects and wonders, which are always interesting to pupils. The course of study is graded. By permission, Prof. Redway's list of books for geographical reading is included.

The Nursery Lesson Book, by *Philip G. Hubert, Jr.* (Putnam, 75 cents), is designed as a guide for mothers in teaching young children. It comprises fifty lessons, each conveying simple and progressive instruction in reading, writing, arithmetic, drawing, and singing. It contains one hundred illustrations in outline and sixteen songs set to music. The page is large, the margins generous, and the general appearance of the book is attractive.

The life and labors of *Vitus Bering, the Discoverer of Bering Strait*, have been recorded in Danish by *Peter Lauridsen*, and an English translation by Prof. *Julius E. Olson* is now published (Griggs, $1.25). Bering was a Dane, who took to the sea in early life, and at the age of twenty-two joined a Russian fleet as a sub-lieutenant. This was during the period of Russia's rapid advancement under Peter the Great. In 1724 Bering, then a captain, was appointed

chief of an expedition to determine whether Asia and America were connected by land. The expedition went overland through Siberia to Kamchatka, where ships were built and the explorations begun. Bering reached the strait that bears his name, and thus proved that Asia and America were separated by water. Soon after his return he proposed a second expedition to chart the northwestern coast of America, then an unknown land, and the northern coast of Siberia. This should lead to the establishment of trade with the American colonies, and also make known a way by water from Russia around to Japan. Bering reached the coast of Alaska in 1741, and died on the way back. For a long time jealousy discredited his results, and the chief object of the present volume is to establish the value of his discoveries. The book also tells the story of the obstacles which he overcame in his expeditions. It is accompanied by two folded maps, and has an introduction by Lieutenant Frederick Schwatka.

The literature of cycling has been increased by a book bearing the title *Cycling Art, Energy, and Locomotion*, written by *Robert P. Scott* (J. B. Lippincott Company, $2). It is largely devoted to explaining the mechanical principles involved in the action of the cranks, wheels, springs, bearings, gears, etc. It includes also brief discussions of the injuries charged against cycling, the bicycle for ladies, English and American workmanship in cycles, aluminum in cycle construction, and the application of steam and electricity to cycles. A second part of the volume comprises extracts from the patent specifications of a large number of velocipedes, cycles, and nondescript vehicles, with the inventors' drawings of the machines and riders, and humorous comments by the author. Many of these machines are astonishing contrivances, and perhaps none more so than the flying-machine, patented March 5, 1889, which is introduced at the end.

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Boston Society of Natural History. Proceedings, Vol. XXIV, May, 1888, to May, 1889. Pp. 256.

Barnes, A. S., & Co.: New York and Chicago. List of Standard Works on Botany and Catalogue of New and Revised Educational Works.

Becker, George F. Geology of the Quicksilver Deposits of the Pacific Slope. Washington: Government Printing-Office. Pp. 486, with Map, and with an Atlas of fourteen sheets.

Bonwill, W. G. A. The Philosophy of Eating and Drinking, from a Medical and Dental Standpoint. Philadelphia. Pp. 21.

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Dabney, W. D. The Public Regulation of Railways. New York and London: G. P. Putnam's Sons. Pp. 281. $1.25.

Darby, John. Man and his World; or, the Oneness of Now and Eternity. Philadelphia: J. B. Lippincott Company. Pp. 259. $1.

Davis, Nathaniel E. Foods for the Fat. American edition, edited by C. W. Greene. Philadelphia: J. B. Lippincott Company. Pp. 188. 75 cents.

Davis, Walter G. Ligeros Apuntes sobre el Clima de la República Argentina (Notes on the Climate of the Argentine Republic). Buenos Ayres. Pp. 254, with Tables and Map.

Donisthorpe, Wordsworth. Individualism. A System of Politics. London and New York: Macmillan & Co. Pp. 393. $4.

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Keyes, Charles R. Johns Hopkins University. Lower Carbonic Gasteropoda from Burlington, Iowa. The American Species of Polyphemopsis Sphærodoma; a Genus of Fossil Gasteropoda. Pp. 24.

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Neal, J. C. The Root-Knot Disease of the Peach, Orange, and other Plants of Florida, due to the Work of Anguillula. Washington: Government Printing-Office. Pp. 30, with 21 Plates.

Newberry, John S. Fossil Fishes and Fossil Plants of the Triassic Rocks of New Jersey and the Connecticut Valley. Washington: Government Printing-Office. Pp. 95, with 26 Plates.

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Platt, James. Money. New York and London: G. P. Putnam's Sons. Pp. 267. 75 cents.

Pope, Colonel Albert A., Boston. Highway Improvement. Pp. 16.

Roberts, John B., Philadelphia. The Cure of Crooked and Otherwise Deformed Noses. Pp. 24. —Delusions in Eye-Surgery. Pp. 8.

Rothschild, M. D. A Handbook of Precious Stones. New York and London: G. P. Putnam's Sons. Pp. 143. $1.

Savage, Minot J. The Effects of Evolution on the Coming Civilization. Boston: The New Ideal Publishing Company. Pp. 24. 10 cents.

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Stroud, William L., Editor. "Eusebia: A Monthly Journal for Bible Students." Oakland, Cal: L. F. Cockroft. Pp. 14. $1 a year.

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Thackeray, S. W. The Land and the Community. New York: D. Appleton & Co. Pp. 223. $1.

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Waller, E., Ph. D. Notes on the Analysis of Zinc Ores. Pp. 5.

Ward, H. Marshall. Timber and some of its Diseases. London and New York: Macmillan & Co. Pp. 295. $1.75.

Whitman, C. O. "Journal of Morphology." September, 1889. Boston: Ginn & Co. Pp. 148.

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POPULAR MISCELLANY.

The American Forestry Association.—The American Forestry Congress at its eighth annual meeting, held in Philadelphia in October, changed its name to Association. The meeting was opened with an address by the Hon. Carl Schurz, in which he narrated the difficulties he encountered from the opposition of Congressmen when, as Secretary of the Interior, he endeavored to protect the forests on the public lands against timber thieves. Mr. B. E. Fernow spoke on "Methods of Forestry Reform," and particularly of what lay within the competency of the Government. Resolutions offered by Mr. Fernow, recommending the withdrawal of all public forest-lands from sale till a permanent system of national forest management can be applied, called out debate. Mr. L. Thompson, a lumberman, argued that it would be contrary to our national usage and the spirit of our institutions to extend the sphere of Government control over interests that have been hitherto successfully managed by private enterprise; that the forests would be better protected by selling the land to citizens than by putting them under the management of office-seekers and politicians. Colonel Edgar T. Ensign held that where large watersheds are involved, and the streams are to be used for irrigation, only national control can be made efficient and adequate; that it is not enough even to leave the matter to individual States. Mr. Richard J. Hinton pointed out the impossibility of adequate supervision by owners or individual States of rivers like those that have their sources in our Western mountain forests. Mr. Fernow's resolutions were adopted. A resolution in favor of removing the duty on lumber was not entertained, for fear of drawing the Association into political controversies.

Lake Ridges of Ohio.—In the American Association paper of the Rev. G. Frederick Wright on "The Relation of Lake Ridges in New York, Ohio, and Ontario," the ridges in Ohio were described as being four in number, and standing at elevations above the sea of 775, 720, 690, and 650 feet. They consist of sand and gravel piled up to the height of from five to twenty-five feet, and approximately parallel with Lakes Erie and Ontario, and are evidently old shore lines of the lakes. The problem of how the water could have been kept up to these several levels seems to have been solved with considerable probability by recent glacial investigations. Attention was called to the fact that the irregularities of the southern boundary of the glacial region are such that if the retreat of the ice front was with equal rapidity all along its course it would have wholly withdrawn from Lake Erie and western Lake Ontario some time before the ice-dams across the Mohawk and the St. Lawrence had been melted away. An inspection of the map shows that two of the most important of these outlets would be, (1) that through Seneca Lake into the Chemung River in New York, and so into the Susquehanna, and (2) that through the Wabash at Fort Wayne, Ind. The heights correspond pretty well with that of the up-

per and third ridges in Ohio, the upper ridge being probably connected with the Chemung River outlet, and the third with the Wabash outlet.

Favoritism at Trinity House.—Prof. Tyndall published a full account, in the "Fortnightly Review" some months ago, of the transactions that led him, in 1883, to resign his position as scientific adviser to the Trinity House. The case, according to his showing, was one of the persistent exercise of personal and political favoritism by the Board of Trade in the experiments for determining what were the best lights for lighthouse purposes. In the competition between the quadriform gas-light of Mr. Wigham, a Scotch Irishman, who had the misfortune to be in trade, and the eight-wick oil-lamp of Mr. Douglass, whose brother was connected with Trinity House, the conditions were arranged so as to be more favorable to the latter. The electric light was then introduced into the competitions, and the proposition gradually assumed a form indicating a disposition to crowd Mr. Wickham out; so that Prof. Tyndall came to the conclusion that "if the treatment of the gas invention and its optical adjuncts could be regarded as a fair sample of the treatment of Ireland by England, it would be the bounden duty of every Irishman to become a Home-Ruler." The evidences of partiality becoming more and more prominent in the action of the board and its committee, Prof. Tyndall felt constrained to resign. Two months afterward the committee went to pieces. Prof. Tyndall observes that some of the parties throughout the transactions seemed to think that Ireland, and not the ships of all nations sailing to its coasts, was the chief beneficiary from the lighthouses.

Interesting Fossils of British North America.—The Cretaceous fossil plants of Port McNeill, Vancouver Island, as described by Sir William and G. M. Dawson, consist chiefly of dicotyledonous leaves, with a few fruits. Large slabs have been procured, some with perfect specimens of the leaves. There are no ferns or cycads in the collection, and conifers are rare. Among the latter are two species of *Salisburia*, or gingko, one of which is "a beautiful little form." The exogenous leaves are very numerous, and belong to a number of genera, with at least twenty species, giving evidence of a very rich and varied forest flora of warm temperate aspect. Sir William Dawson has made an interesting study of the *Balanus hameri* of the Pleistocene of Rivière Beaudette, a species which is still living in somewhat deep water on the Canadian coasts. The specimens under consideration were found farther west than any point at which the fossil had been previously observed, and are interesting from their remarkable perfection and the large masses which they form. The original attachments of the animals, so far as observed, were on pebbles on the surface of the clay, and, as these afforded space for only one or two individuals, the young were obliged to attach themselves to the old in successive generations. Most grotesque groups were thus formed, which still remain entire. Observations of peculiar varieties of the mussels *Mya arenaria* and *Mya truncata* in the modern sea and in the Pleistocene have led the same author to remark upon the interesting feature of "the companionship of these allied species in the North Atlantic throughout the Pleistocene and modern periods, and their range of varietal forms applicable to each, according to the conditions to which they have been exposed, along with their continued specific distinctness, and the preference of each for certain kinds of environment; so that in some places one and in others the other predominates, while this relative predominance, as well as the prevalence of certain varietal forms, might no doubt be reversed by change of climate or depth."

The Cretaceous Inland Sea.—In the course of two years' study of the northern and eastern terminations of the Texas Cretaceous deposits, Prof. Robert T. Hill has found that the marine sedimentation of both divisions of the formation was limited on the north by an older continental shore line, the present remnant of which extends from the Ouachita River, near Malvern and Hot Springs, Arkansas, almost due west through Indian Territory into the Panhandle of Texas. The whole Cretaceous history, including the upper and lower systems, can be summed up as two profound subsidences, separated by a land epoch, which have left in

their sediments two great chalk formations. During the second subsidence, which was the deepest in all Mesozoic times, the Atlantic Ocean extended continuously from British America southward around the Appalachian continent. Prof. Hill has begun the publication of a series of illustrations of the paleontology of the Cretaceous formations of Texas, in which pictures and outlines of characteristic fossils are given, with letterpress descriptions. The first number thus represents *Pecten* (*Vola?*) *Roemeri Pterocera Shumardi*, and *Crioceras?* (*Acayloceras*) *Texanus*—all new species, of the Comanche series, or Lower Cretaceous.

An Orthodox Compliment to Darwin.—The first number of the "Cumberland Presbyterian Review" (Nashville, Tenn., January, 1889) contains a broad and enlightened article on "Charles Darwin," by Prof. J. I. D. Hinds. The author, whom the company in which he appears attests to be orthodox, looks at Darwin's doctrines on their merits, without regarding their seeming bearing on questions that are equally liable to be misunderstood with those with which the theory of evolution deals. "When a man wins distinction in this world," he begins, "it is customary to condemn him outright if his teaching happen to be in conflict with the consensus of mankind. This is natural, but at the same time very unwise; since it has thus often happened that theories have been placed under the ban which have afterward been proved true. . . . If Darwin found the correct explanation of the phenomena of the organic world, his theory will stand the test of investigation and logic; if not, it must take its place with other theories which have served their day, and have yielded to better ones; she must be content to leave the decision to the scientist and the philosopher, and we can certainly have no reason to reject their final conclusion. . . . The Christian, of all men, should have the greatest confidence and repose of mind in the face of the investigations of the present day: for, if his religion be true, its foundations can not be shaken; and, if it be false, he has nothing to lose." Of Darwin's theory, undoubtedly its first tendency "is toward infidelity and skepticism. But since the world has become familiar with it, and has found that it is simply an attempted explanation of the ordinary course of nature, to be placed side by side with Newton's law of gravitation, Copernicus's theory of the solar system, the nebular hypothesis, and the geological eras of indefinite time, it has ceased to be atheistic, and is likely soon to become itself one of the arguments of natural theologians." Of Darwin's agnosticism, "his religious views and the changes through which they passed were but the natural outcome of the course of his investigations and studies. He was a pioneer, and could not see the true ethical import of the doctrine which he promulgated. Like many other investigators, he contrasted the ideal of God to which his theories led him with theological dogmas and the prevalent anthropomorphic conceptions of Deity. His training had been Calvinistic, and the freedom which he found everywhere in nature did not accord with the Calvinistic idea of fatality and the arbitrary action of the supernatural will." Finally, "In truth, let me ask, how much worse is it to have pithecoid ancestors than to be a beast in *propria persona?* The great question with us is, not whence we came, but what we are, what we should be, and what we are destined to be."

The Moving Forces of Meteorite Swarms.—An attempt has been made by Mr. G. H. Darwin to apply the kinetic theory of gases to the case of a swarm of meteorites in space. The individual meteorites are analogous to the molecules of the gas, and the mass of gas corresponds, in the author's theory, to the whole solar system. Lockyer and Sir William Thomson have expressed their conviction that the present condition of the solar system is derived from an accretion of meteorites, but the idea of fluid pressure seems necessary in explaining present forms of equilibrium. The author proposes to reconcile the two theories by showing that the laws of fluid pressure apply to a swarm of meteorites which is condensing to a solid form. The case of an infinite atmosphere of equal-sized meteorites is considered, and then the case of meteorites of very different sizes. In the case of a swarm of meteorites condensing under the mutual attractions of its parts, the author shows that the larger meteorites will gravitate toward the center of condensation,

and that consequently the mean density of the condensed mass will decrease from the center toward the circumference. During the process of condensation the condensing mass will first gain by accretion of meteorites; then a balance will be maintained between those which remain on the condensing mass and those which rebound from it; and, finally, more will be lost by rebounding than gained by accretion.

The Sacred Maori Axe.—The thought of a connection between ancient stone weapons and thunder is widely diffused, and has a hold even in European minds. A curious illustration of its character has been communicated to "Nature" by Mr. Edward Tregear, of Wellington, New Zealand., in the shape of a translation from a Maori newspaper of the story of the finding of the sacred axe, Te Anhiorangi, which had been hidden by a remote ancestor, and had not been seen again till December, 1887. A party of Maoris had gone out to gather the edible mushroom. With them was a young woman, a stranger in the district, and ignorant of the sacred places. Wandering away by herself, and looking here and there for funguses, "she saw a tree on which there was a fungus, and laid her hand on it, but suddenly there came the flash of the axe. Following with her eyes the direction of the flash, she saw the axe close against the foot of a pukatea-tree; a cry of terror broke from her, and she fled screaming. At the same time the thunder roared, the lightning flashed, and blinding hail burst forth in sudden storm, increasing her terror almost to madness. Her husband heard her cries as she flew along; but an old man, called Te Rangi Whakairione, directly he heard her shrieks, understood the reason of the outcry, so he began to chant an incantation, and the fury of the storm abated. When the party had assembled in the open land, the old priest asked which of them had been to Tieke; whereupon the girl asked, 'Where is Tieke?' The old man answered that it was beyond the turn at Waione. Tomairangi replied: 'I have been there, but I did not know it was a sacred place; I saw something that looked like a spirit, and I am full of great fear.' Then all the party went to ascertain what it was, and then they found that it was indeed the lost sacred axe, Te Anhiorangi. After Te Rangi Whakairione had chanted another incantation over it, they all took hold of the axe, and wailed over it. When the crying had ceased, they brought the axe back to the settlement." The tradition had long existed that the axe was at the spot where it was found, which had therefore been tabooed, and never visited until on this occasion. On the next day the sacred thing was hung up on a tree, that all might see it, with imposing ceremonies of a procession and priests reciting charms and incantations. "All the people carried green branches in their hands as an offering to Te Anhiorangi. When the concourse drew near the place, successive peals of thunder and flashes of lightning rent the air; then came down a dense fog, making it dark as night. The Tohunga (priests) stopped the thunder and dispersed the darkness by their incantations. When the light again appeared, the people offered the green branches, together with a number of Maori mats, etc.; then they made lamentations, and sang the old songs in which the ancient axe was spoken of by their forefathers. The pedigree of the axe, which was a stone weapon of extremely high polish, was traced back to the first Maori chief who came to New Zealand; and to him it had descended, through the great god, Taue, from the primeval pair, Heaven and Earth.

Remedies for Sleeplessness.—Correspondents of the London "Spectator" have been supplying that journal with various remedies for sleeplessness. A curate in London is afflicted in direct proportion to the mental worry and absence of air and exercise he has to endure, and finds that "to walk even one mile in the day is a great thing" in the way of a remedy. At the moment, he says, the best thing one can do is to get up, drink half a glass of water, and walk round the room. The slight alternation of cold and warmth has a soporific effect. For a permanent result: "Live healthily. Avoid too little and too much exercise, food, particularly wine. Dine lightly, eating very little meat; drink only one glass of wine. Bathe an hour before dinner, not before going to bed. . . . Do something in the evening that does not excite you, something like whist that does itself mechanically. Decide how

much sleep you ought to have—say, eight hours—and get up sternly when you have been in bed eight hours, however long you have been awake. Increase your air and exercise gradually." A journalist, when suffering from an over-excited brain, and finding his eyes in constant movement, although the lids are closed, resolutely fixes the gaze downward—say, to the foot of the bed—while the lids are kept closed. If his sleeplessness arises from flatulence, he takes a remedy for that. "A most wretched lier-awake" of thirty-five years' standing, who had for ten years thought himself happy if he could get twenty minutes' sleep in the twenty-four hours, took hot water—"a pint, comfortably hot, one good hour before each of my three meals, and one the last thing at night—naturally, unmixed with anything else. The very first night I slept for three hours on end, turned round, and slept again till morning. I have faithfully and regularly continued the hot water, and have never had one 'bad night' since. Pain gradually lessened, and went; the shattered nerves became calm and strong, and instead of each night being one long misery spent in wearying for the morning, they are all too short for the sweet, refreshing sleep I now enjoy."

The Mental Torpor Remedy.—Complete intellectual torpor is recommended as a remedy for overweariness by a writer who, to sustain his view, brings pertinent illustration to the support of argument. Such a condition is almost superstitiously avoided by hard-working men, who are disposed to regard it as a waste and an idle indulgence. But "there is no more harm in intellectual torpor for the sake of the mind's health, than in sleep for the sake of the body's health; and its duration ought to be governed only by expediency. . . . As to the curative effect of torpor, we have no doubt whatever. So far from the mind being weakened by total rest, or the energies diminished, both wake after a time fully recovered, and repossessed of the old readiness to exert themselves to fatigue. 'I am tired,' says the cured man to himself, 'of doing nothing'—that is, he has recovered the power to do things easily, which is the mark of mental health. The mind itself is, in fact, often positively stronger, having grown in its sleep as the body grows, and having, so to speak, resharpened its weapons, till the 'lazy' mathematician can not only solve his old problems more quickly, but can recollect them more accurately, the mind having gained, as in boyhood it gained, from sleep. We can all recollect how in school-days the lesson of the evening was often best known on the following morning, although, if torpor weakens, we ought in the intervening twelve hours to have invariably lost some slight grip of the words, instead of gaining a fresh one. The memory in particular recovers under this process in the most amazing way, so that even the permanent weakness, the slowness of recollection which comes of advancing years, seems to disappear. The grand gain, however, is in mental nerve, in the disappearance of that apprehensive anxiety and sense, not of strain which is, but of strain which is coming, that, far more than actual toil, however severe, shatters men's powers to pieces. But how is torpor to be attained? Like everything else, by determining to have it—that is, by a persistent resolve to be lazy, to do nothing, read nothing, think nothing, and say nothing, that involves the smallest upspringing of the sense either of trouble or of effort."

Animal Language.—Whether animals can "talk," and men can learn to understand their "language," is the subject of an article by Mr. F. G. Frazer in the "Archæological Review." A critic of the paper denies the human part in the matter, and declares that the supposition that men can learn to understand animals to the extent implied "is a direct contradiction to universal and unbroken human experience." All representations asserting such an achievement as a fact, or assuming its possibility, are vain boastings or imaginings. Yet beasts and birds all utter sounds, and sounds that have meaning to them, and meanings which to a certain extent we can understand. "They all utter, or at least they all seem to utter, the same sounds to express the same emotions. The love-cry of the nightingale, the low by which a cow recalls a straying calf, the grunt of a pig when it sees food, the mew of a cat who wants the door opened—that is, wants to attract attention—the bark

of a domesticated dog to testify recognition, and the howl of an uncivilized dog as the moon rises, or of a civilized dog when the church-bells begin, are all, to human ears at least, unchanging sounds, sounds with one meaning and no other." So with numerous other familiar sounds peculiar to certain animals, and well understood; but they can not be regarded as "language" in the sense in which the term is used in the proposition under review. An interesting detail of the discussion concerns the grating sound—not unlike the "gnashing of teeth"—of the scolding or "swearing" of birds, which they utter also evidently in play—as kittens and dogs are also fond of playing bite, and dogs bark. However much there may be that one can not learn of the "language of animals," the study of the little that is at our command is enough to furnish profitable as well as amusing occupation.

A Glance at Cambodia.—A French traveler, writing from Penompein, the capital of Cambodia, says that "in passing from Cochin China to Cambodia, the difference between the Cambodian and the Annamite type is very striking. The Cambodian is almost the height of Europeans, and is idle and dirty, while the Annamite is small and active. A full-grown Annamite woman is like a French girl of twelve. A book on Cambodia would be very interesting. The banks of the river are covered with luxuriant vegetation. The entire territory and its inhabitants belong absolutely to the king, who lives here, with a second and third king besides him, while a fourth king is stationed in the interior. He has three hundred wives, chosen from the handsomest women in the whole country. The second king at present is in opposition to King Merodom. All the Cambodians are the king's earmen or slaves, and pay him rent. . . . The country is a most curious one. Elephants are very numerous here, and wander about in freedom through the brushwood, like oxen in the meadows of France. The capital of Cambodia consists of only one street, which is nearly four miles long. In all the town there are not ten houses built of stone or of bricks, and those so built are public buildings. All the officers are lodged together in two *payothes*, which are almost contiguous. A *payothe* is composed of a wooden floor resting in turn on a scaffolding of bamboo. The walls are formed of a trellis of straw or leaves, in the style of the thatch of cottages all over Europe. If you push with your finger a little strongly, it will pass through the wall. The roof is of thatch. The furniture is very primitive. It consists of a bed, formed of a frame in bamboo on which is placed a mat, and a table."

Stages of Himalayan Vegetation.—General R. Strachey describes the changes which the traveler meets in ascending one of the great mountain-ranges, as embodying a compendium of the climates and vegetation of the entire globe. Nowhere can such a display be better or more easily obtained than upon the Himalayas. The transition is abrupt from the well-cultivated plain of northern India, with its fields of rice and millet, or golden-flowering mustard, to the dense, umbrageous forests along their base, almost wholly composed of trees of tropical forms, with a few oaks and an elm, which, with a tangled growth of undershrubs and creepers and epiphytal plants, give cover to the elephant, the rhinoceros, and tiger, and afford shelter to the peacock and other gayly colored birds. The glens are choked with gigantic grasses and feathering bamboos. Great forests cover the outer ranges of the chain, scandent palms spreading over the lofty trees, whose stems are splendidly furnished with the dark-green foliage of climbing aroids; the ground beneath them is concealed under a rich growth of tree and other ferns, orchids, and *Scitamineæ*, or broad-leaved plantains. With gradually increasing elevation and falling temperature the character of the vegetation changes. More open woods of evergreen trees, typical of warm temperate climates, succeed, including rhododendrons, oaks, and laurels. Lofty pines cover the vast mountain-slopes through many thousand feet of altitude in unbroken uniformity. Still ascending, are reached forests of deciduous trees of surpassing size and beauty, crowning the hill-tops and fringing the courses of the rivers, intermingled with many flowering shrubs and an abundant display of herbaceous plants, of which, at the greater elevations, the forms are for the most part allied to or identical with

those of Europe. The arboreous vegetation, the last members of which are commonly birches, pines, and junipers, usually ends at about twelve or thirteen thousand feet above the sea-level, the shrubby growths ascending a thousand feet higher. The Alpine region is thus attained, where, under the influence of the frequent showers that fall upon the mountain-slopes exposed to the south, the open pastures are adorned, during their short summer, with flowers of every hue and in the greatest profusion and luxuriance, including well-known European forms, such as gentian, primula, anemone, ranunculus, and many others. With increased elevation, and as the ranges are less directly exposed to the rain-bearing winds from the south, the climate becomes colder and drier, the vegetation more scanty, the forms fewer; and on reaching the border of Thibet, at an elevation of fourteen or fifteen thousand feet, where the atmospheric conditions are wholly changed, the aspect of the country is that of a desert — treeless and bare, as a rule—and, excepting in the rare neighborhood of water, not one twentieth of the surface is clothed with vegetation, and such bushes as there are seldom rise to a greater height than one or two feet.

Experimental Fields at Rothamstead.—The grass-land experimental field at Rothamstead consists of about seven acres, and is divided into twenty plots. It has probably been laid down in grass for some centuries. It is certain that no fresh seed has been artificially sown within the last fifty years; and there is no record of any having been sown since the grass was first laid down. The experiments were begun in 1856, when the herbage was uniform in character. Each plot has been treated differently. One has had no manure, others have had farm-yard dung, superphosphate of lime, ammonia salts, sulphate of potash, or other chemicals. Sir John Lawes said to a writer in the "Pall Mall Gazette," who visited the farm, that "the result was evident in many ways. On one plot the fertilizers supplied had fed only a single kind of grass, which had covered the whole area, killing out all the rest. On another the grass was hard and wiry, scarcely fit for food; and on yet another the land was little better than a bog. We can not go into technical details as to the results, but these experiments have shown that the food which plants receive, either artificially from the soil, or by the atmosphere, determines their nature as much as in the case of animals. The same thing is seen in the wheat and barley fields. One of the most important of the former is a section upon which the grain has been grown continuously for forty-five years, in one case without manure. The average of the first recorded eighteen years gave 14¼ bushels per acre, and last year the same quantity was produced, showing that in the soil there is a large reserve amount of fertility." In another part of the field, Sir John Lawes told the writer: "Five years ago we left the upper end of this wheat-field uncropped, allowing the corn to fall when ripe. In three years there was scarcely a single ear of corn left; those which I could find were short in the stalk, and with perhaps a single grain. Now there is not one. This shows that food-products are almost entirely artificial, and that in a few years the land would be a perfect wilderness, if uncultivated. But I myself was surprised at the rapidity with which the wheat disappeared." This was explained thus: "The weeds were stronger, and killed out the artificial grain. Weeds are hardy, and it is really 'the survival of the fittest' or the hardiest. The same thing I can show you in the turnip-field, where the unmanured plot is almost barren, the plants having scarcely in any case formed a bulb. It is the starch we want as food. Cultivation and fertilization give that starch."

Palm-Oil.—Palm-oil is the product of the fruit of the oil-palm tree of Guinea. The fruit grows in clusters on top of the tree, which is about thirty feet high, and resembles a chestnut. The oil is extracted by boiling the pulpy and fibrous mass around the central nut, and is used in making soap and candles. The fruits are harvested in April. The oil of *Arachis*, which is equally important in commerce, is from the nut of the *Arachis* (peanut), thousands of tons of which are sent to Europe every year to be made up into "olive-oil." It is the fruit of an annual creeping plant (*Arachis hypogea*), and ripens in July and August. Oils of inferior quality are made into soap. Another underground nut (*Voandzeia subterranea*)

affords a white, hard butter, richer than butter from the cow, which has the further advantage of remaining fresh for a whole year without being salted. Only limited quantities of this product have as yet come into the market. The native Africans use all these fruits, under one form or another, for their own alimentation.

Flowers and Perfumes.—The rose is extensively cultivated in the Balkan Peninsula, chiefly for the sake of the perfume it affords. The Provence or cabbage rose, it is said, will yield in the second year from one hundred to two hundred bushels of flowers per acre, weighing six pounds to the bushel. The rose harvest at Adrianople sometimes yields about ninety-four thousand ounces of attar of roses; the average of the Bulgarian harvests in the past ten seasons has been fifty-seven thousand ounces. The price of this perfume has declined fifty per cent since 1883. The Moors in Algeria extract an attar of moderate value from the indigenous double white musk rose. Twenty-eight tons of rose-leaves were imported into Aden in 1886, of which half were shipped to India. The "ixora extract" is made from the soka-flower (*Parvelta angustiflora*); frangipanni, from the flowers of species of *Plumeria*, native to the West Indies and some parts of South America; the essence and pomade of *cassie*, of the French perfumers, from the flowers of *Acacia farnesicina*. About one hundred tons of these flowers are used in Cannes yearly, individual makers working up one hundred thousand pounds. The fragrant white flowers of *Bligkia sapida* and of the Bukul (*Mimusops Elengi*) are used for making distilled waters; and the flowers of spikenard (*Andropogon nardus*) are employed in Algeria for perfuming hair-oils and cosmetics. Moorish women form garlands to ornament the interior of their dwellings from the flowers of the jasmine, and obtain a perfume by steeping them with oil in bottles, which are exposed to the sun. The same process is applied to the flowers of the tuberose and the cassia. Hungary water is distilled with spirit from the tops of rosemary-flowers. Twenty tons of violets are used annually in Nice and Cannes, and one hundred and twenty tons of orange-blossoms in Nice. Orange-flower water is one of the most agreeable vehicles for nauseous medicines that we have. Rose-buds are made into preserves in Arabia; the blossoms of the shaddock are used for flavoring sweetmeats, and the fleshy calyces or flower-bracts of the Indian sorrel, a *Hibiscus*, having a pleasant acid taste, are made into tarts, jellies, and refreshing drinks in India. The petals of flowers are much used in Roumania for flavoring preserves, of which not less than one hundred and fifty varieties are made.

NOTES.

Attention has been called, in letters written by Mr. James R. Skilton to the Mayor of Brooklyn, to the dangers that are hidden in the pipes through which water-gas is conveyed into houses and in the meters. The pipes and the meters are often—it would hardly be too much to say, usually—leaky, and as the escaping gas, largely carbonic oxide, while extremely poisonous, is imperceptible to the senses, great harm may be and often is wrought before the family are aware that anything is wrong. It is hard, even when the nuisance is known to exist, to force timely attention from the companies furnishing the gas, and, when they do send men to make repairs, the work is, as a rule, done in the most negligent manner. Mr. Skilton has no doubt that "hundreds of people are sacrificed every year to the Moloch of the gas-meter."

In the "Monthly" for July there is a note in which Asamayama is spoken of as the highest active volcano in Japan. This is popularly correct, but is not scientifically exact. Asamayama is 8,284 feet high (Rein). The last fatal eruption took place in 1783, and the last emission of ashes occurred in 1870, while the evidences of volcanic eruption are much more conspicuous than they are around Fujiyama, the height of which is 12,287 feet (ibid.), and which has been quiet—i. e., not violently active—since 1707. But when one sees the "hot" place on the side of Fuji, it becomes very apparent that the activity of Asama is very little greater than that of her peerless sister. The heat at one place on Fuji is so great as to be perceptible to the hand. Snow will not lie; and it is said that there is an escape of steam.

Borings of rock-salt at Ellsworth and Kingman, Kansas, were described by Mr. Robert Hay at the meeting of the American Association. The veins were discovered in April and August, 1888. One hundred and fifty-five barrels of salt were manufactured in Kansas in 1888, and it is estimated that the output of 1889 will not be less than three times as large.

RESPECTING "artists' colors," Dr. A. P. Laurie said, in the British Association, that one point that came out in the course of his inquiries about the colors used by the old masters was the fact that they largely employed vegetable pigments, many of which were not used by modern painters. His researches into the ordinary methods of manufacturing colors showed that great variations prevailed in different makes of the same color, and the matter was an important one to look after. One of the most valuable oils used by the old masters was that of the walnut.

THE work of Columbus is to be commemorated in Italy according to a scheme adopted by a Royal Commission, which includes the publication of a "Raccolta Colombiana" in six volumes, devoted to (1) the writings of Columbus; (2) Columbus and his family; (3) the discovery of America; (4) navigation and cartography of the discovery; (5) monographs (Italian precursors and continuers of the work of Columbus); (6) bibliography. This work will apparently be the outcome of a large amount of diligent research.

THE establishment of a biological laboratory for the observation and study of fresh-water *Algæ* was suggested by Mr. William R. Dudley, in a paper read at the meeting of the American Association.

PROF. J. W. MALLET has found, in experiments upon alum baking-powders, that most of the preparations of that class in the market are made with alum, the acid phosphate of calcium, bicarbonate of sodium, and starch. Among the resultants of the chemical changes by baking are aluminum hydroxide and phosphate. These substances, in doses not very greatly exceeding such quantities as may be derived from bread as commonly used, produce an inhibitory effect upon gastric digestion. This effect is probably due to precipitation in insoluble form of the organic substance constituting the peptic ferment and of some of the organic matter of food. Hence it is concluded that "not only alum itself, but the residues which its use in baking-powder leaves in bread, can not be viewed as harmless, but must be ranked as objectionable."

ACCORDING to a calculation furnished us by Prof. William Harkness, of the Naval Observatory, "a body weighing one pound avoirdupois on a *spring balance* at the earth's equator would weigh only 0·16584 of a pound, or 2·6534 ounces, upon the same *spring balance*, at the moon's equator. In the statements on this subject appearing in books the centrifugal force is neglected. It amounts to 24 grains in an avoirdupois pound of 7,000 grains.

ACCORDING to a paper by Prof. Wiley, in the Society for promoting Agriculture, the butter of cows fed on cotton-seed is marked by the presence of a small supply of volatile acid and a high melting-point. The power possessed by cotton-seed oil of acting on silver, passes through the animal, and appears in the butter made from its milk—a fact which shows that substances can be carried directly from the food to the butter. A new standard of analysis will have to be adapted to the butters of cows fed on cotton-seed oil, for the low amount of volatile acid contained in them would cause them to be condemned as spurious.

THE relative values as foods of the grains named below are given by Prof. Wiley as, first, wheat; second, sorghum; third, maize; fourth, unhulled oats. Sorghum-seed furnishes a flour like buckwheat, that makes passable bread, and is coming into considerable use.

THE workmen in the Venetian glass factories at Murano, according to Dr. Salviati, fall victims in time to failure of eye-sight and ultimate blindness, caused by the excessive heat and intense glare of the furnaces. As they live simply and receive high wages, they are usually able to save enough before the disability comes upon them to support them for the remainder of their lives.

PROF. RENZI, of Naples, has reported cures of tetanus by securing absolute rest for the patient—that is, rest for the senses as well as for the body. The patient's ears are closed with wax, his room is dark, and the floor is heavily carpeted. His nurse attends him with a shaded lantern; he is served food that requires no mastication; and sedatives are given to relieve pain. It is not pretended that this treatment shortens the period of the disease, but that it lessens the force of the paroxysms, which eventually cease.

EXPERIMENTS by Dr. Pinel show that hypnotic patients will obey the directions conveyed to them mechanically by the phonograph as readily as they will obey living words. Hence, he argues, the theory of animal magnetism—that is, of a magnetic current passing from operator to subject—is baseless; and the real cause of the phenomena of hypnotism is a disordered mental state.

A. W. BUCKLAND has endeavored to restore to the moon the credit that has been snatched from it of having influence over the weather and the welfare of men. Some of the superstitions relative to the moon may be traced to the old moon-worship. For others, Mr. Buckland assumes, ground may be found in fact. Meteorologists deny any influence of the moon upon weather; but the moon raises the tides of the ocean, and it also creates tides in the air, which have received no attention from science. We are ignorant of the forces that may reside in the air-tides and of the phenomena that may be dependent upon them.

MR. BOSWORTH SMITH, in a report on the Kolar gold-field, in southern India, records some finds of old mining implements, old timbering, fragments of bones, an old oil-lamp, and broken pieces of earthenware, including a crucible, the remains of ancient mining operations. He expresses astonishment at the fact that the old miners were able to reach depths of two hundred or three hundred feet through hard rock, with the simple appliances at their command.

BUFFALOES are said to be becoming very abundant and increasing rapidly in northern Australia, where they were introduced about 1829. They are described as being massive and heavy, "with splendid horns," and affording fine sport for bold hunters.

IN the discussion in the British Association of the report of the Committee on Science Teaching in the Elementary Schools (which exhibited a continued decline), Sir Benjamin Browne said that the school boards would be amazed at the high standard of the qualifications of the lads who came to his firm to be apprenticed engineers. Recently a boy thirteen years of age came to him, and he failed to puzzle him with problems from Euclid. His opinion was, that whatever could be done voluntarily was better than what could be done by the Government.

DR. D. G. BRINTON, of Philadelphia, announces as in press a collection of sacred songs of the ancient Mexicans, entitled "Rig Veda Americana," with a gloss in Nahuatl, paraphrase, notes, and vocabulary. The texts are derived from two Nahuatl manuscripts, one at Madrid and the other at Florence, both of which have been personally collated by the editor. This volume will form number eight of the "Library of Aboriginal American Literature."

AN instrument called the telegraphone has been patented, which enables the sender to record his message on a cylinder attached to the receiving instrument, in the absence of any one to hear it, and even to repeat the message back to himself for correction.

MR. DE CORT SMITH, at the American Association, exhibited specimens of the Shamanic masks and rattles of the Onondaga Indians, and exemplified their use. The masks are symbolical of supernatural evil beings, and their aid is invoked to drive away witches. The spirits are believed to cause or remove illness. They are propitiated with feasts and sacrifices of tobacco.

OBITUARY NOTES.

PROF. VICTOR EGGERTZ, late head of the School of Mines of Sweden, died in Stockholm in the last days of August. He was the inventor of what is called the coloration test for analyzing carbon in iron and steel.

MR. E. F. H. FRANCIS, Professor of Chemistry in Queen's College, Georgetown, Demerara, and analytical chemist to the Government, has recently died, aged thirty-nine years. He went to the service in British Guiana from a similar position in Trinidad in 1875.

SEÑOR DON SEBASTIAN VIDAL, who died at Manila July 28, 1889, had been for several years Inspector-General of Forests and Director of the Botanic Garden at Manila, and was the author of several works on Philippine botany. He was practically a pioneer in the investigation of the Philippine flora, and has determined several peculiarities distinguishing it from the allied Malayan flora.

MR. JOHN BALL, F. R. S., a distinguished traveler, Alpine explorer, and botanist, of England, died in London, October 10, 1889, soon after returning from an excursion to the Dolomite Alps. He was born in Dublin in 1818; won high mathematical honors at Cambridge; was called to the bar, and appointed an assistant Poor Law Commissioner, served in Parliament and as Under Secretary for the Colonies, and then withdrew from public life and devoted himself to Alpine exploration and botany. He accompanied Sir Joseph Hooker to Morocco, and wrote an account of the botany and natural history of the highlands of that country. He also visited Peru and Patagonia and the Island of Teneriffe, for scientific exploration. He published an "Alpine Guide," which is spoken of as a work of standard merit.

THE distinguished French chemist, Dr. Augustin Quesneville, died on the 4th of November, 1889, aged eighty years. He was a pupil of Vauquelin's, and succeeded him in his factory. Having attended Chevreul's lectures, he was admitted as a doctor of medicine in 1834, from which time he devoted himself to the study of science and industrial chemistry. In 1840 he founded a monthly journal, called at first the "Revue Scientifique," but after 1857 the "Moniteur Scientifique," devoted to chemistry and its industrial applications. This journal was continued till October last, when the veteran editor gave it up, on account of the pressure of old age.

"CIEL ET TERRE" records the death, on the 10th of October, in his sixty-sixth year, of M. François Henri Carlier, proprietor and director of the Meteorological Observatory of Saint Martin-de-Hinx in the Landes. This establishment is described as having been a model one, and better furnished than many state-supported observatories. The observations taken there under M. Carlier during the past twenty-five years form one of the most important contributions to the study of the climate of the extreme southeast of France.

JAMES GLAISHER.